

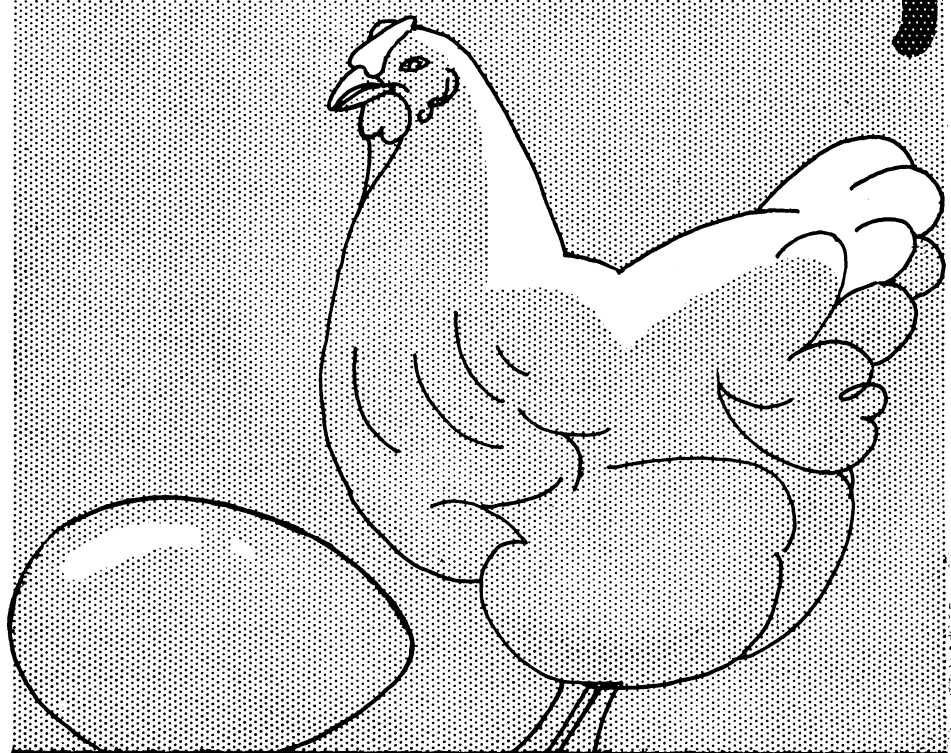
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**DISEASES AND
PARASITES OF**

Poultry



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CHICKENS, turkeys, ducks, geese, pigeons, and other species of poultry are susceptible to many diseases, some of which affect only part of a flock, whereas others are highly infectious and may spread through the flock and may also be carried by one means or another to neighboring flocks, producing extensive outbreaks, or epizootics.

Nutrition has been shown to have an important influence on health and productiveness of poultry. The lack of certain vitamins, minerals, or other food elements is likely to establish fairly definite disease symptoms. On the other hand, an excess of some food substances may also be detrimental to the birds' well-being. Likewise, roomy, comfortable, and well-ventilated living quarters are essential to the health and productivity of the flock.

Poultry are also infested by numerous kinds of parasites, some of which live on the surface of the body and others internally, especially in the crop, stomach, and intestines. These parasites may seriously affect the health of the birds by preventing their nourishment and by causing irritation and inflammation of the parts which they attack.

Certain diseases respond favorably to treatment. Others resist all efforts at treatment and cause heavy losses.

Preventive measures properly applied offer the surest means of controlling diseases of domesticated birds.

The purpose of this bulletin is to inform the poultry owner as to the characteristics of the various diseases and infestations in order that he may intelligently use the most approved methods of combating them. However, it is in no sense intended to replace the valuable service and advice of the trained veterinarian, which, if available, should by all means be obtained.

This bulletin is a revision of and supersedes Farmers' Bulletin 1337, Diseases of Poultry.

DISEASES AND PARASITES OF POULTRY¹

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¹ This is a revision of former editions by John S. Buckley (deceased), Hubert Bunyea (deceased), and Eloise B. Cram.

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NATURE AND IMPORTANCE OF POULTRY DISEASES

DOMESTIC BIRDS are subject to a considerable number of diseases, some of which spread rapidly through the flock and cause high mortality. They may also be infested by various kinds of parasites, some of which live on the surface of the body and others in various passages or organs within the body. These parasites are injurious because they take part of the nourishment which should be used by the bird to put on flesh or to produce eggs, and also because by their movements and other activity they cause irritation and inflammation of the parts they attack.

The contagious diseases which are caused by germs and viruses and the weakness and loss of flesh caused by the larger parasites just mentioned are the most important conditions which the poultryman has to consider in the endeavor to keep his birds healthy. These germs, viruses, and parasites, should be kept out of the flock by suitable preventive measures, because disease may be avoided much more easily and cheaply than it can be cured. The aim in studying the diseases of poultry is, therefore, to learn how to prevent the diseases as well as how to control them once they become established.

DISEASE PREVENTION

To prevent diseases, we need to understand something about them. Some diseases are caused by infection; others result from faults of nutrition; and still others are traceable to the general conditions surrounding the flock.

The first rule of health is sanitation. The observance of this rule comprises the following points: (1) Quarantining of new stock until it is known to be healthy; (2) protecting the flock from access to polluted drinking water, spoiled or infected feeds, or contaminated grounds; (3) burying, burning, or otherwise making proper disposal of diseased carcasses; (4) thoroughly cleaning and disinfecting premises contaminated by disease; (5) protecting the flock from diseases and

parasites carried by free-flying birds; and (6) preventing persons who own unhealthy chickens from entering the poultry yards or houses.

Proper nutrition is the second rule of health. Some diseases are caused by a ration lacking certain elements, while others are due to excessive feeding of some feeds. Rickets, nutritional roup, polyneuritis and perosis are deficiency diseases, whereas obesity and gout are attributed to the feeding of diets that contain excessive quantities of certain substances. A balanced ration with meat scrap and shell or bone, a regular allowance of green feeds, and clean water, should contain all the vital elements of nutrition ordinarily required by birds.

The third rule of health is good surroundings; that is, roomy, comfortable, well-ventilated poultry houses, free from drafts or dampness, and with ample provision for exercise and suitable exposure to the direct rays of the sun.³ In this connection, it has been conclusively demonstrated that the use of deep litter (4 to 6 inches), together with the generous application of hydrated lime, 10 to 15 pounds per 100 square feet, and stirring the litter whenever necessary to maintain it in a dry, loose condition is conducive to poultry health. The use of this system makes frequent changes of litter unnecessary and aids in checking the development of disease-producing organisms. The use of lime on the dropping boards or in the pits keeps down odors and discourages the breeding of flies.

Limiting the size of poultry units aids in controlling the spread of disease. Birds of various ages and of different species should be kept separate.

DISEASE CONTROL AND ERADICATION

The extensive use, in recent years, of artificial and wholesale methods of incubation, housing, and feeding has increased the opportunity for disease development and transmission at an alarming rate so that disease has become one of the greatest barriers to success with poultry. New and baffling diseases are springing up, and their diagnosis and control are essential.

Normal, healthy chickens do not require drugs of any kind. When an outbreak of disease occurs in a flock the first procedure is to get an accurate diagnosis. This can be done best by the local veterinarian, but if no practicing veterinarian is available, it is a good plan to communicate with the State agricultural experiment station. If the disease proves to be a contagious one, the next step is to remove the sick birds from the flock. Remedies and curative treatments are useless in most of the devastating contagious diseases, and the treatment of sick birds increases the opportunity for the spread of the disease to the rest of the flock. The proper handling of contagious diseases consists in sanitation, preventive treatment, and eradication rather than cure.

Diagnostic tests for the contagious diseases such as pullorum disease, fowl typhoid, tuberculosis, and Newcastle disease, as well as vaccination against laryngotracheitis, fowl pox, and Newcastle disease, should be handled by a person experienced in poultry disease control.

³ Additional information on the correct feeding and housing of poultry is contained respectively in Circular 788, Nutritive Requirements and Feed Formulas for Chickens, and in Farmers' Bulletin 1554, Poultry Houses and Fixtures.

DISINFECTANTS AND THEIR APPLICATION ⁴

Good disinfectants destroy the germs of contagious diseases, and in some cases, external parasites such as lice and mites. Since the germicidal power of disinfecting solutions is rapidly spent by contact with organic matter it is always important to give special attention to the cleaning of the premises, the removal of all litter, contaminated soil, and manure, before applying the disinfecting solution. The disinfectants should be thoroughly applied to the interior of the houses, worked into all the cracks and crevices, spread over the ceiling and the floor, the roosts, dropping boards, nest boxes, and feeding and drinking vessels. Merely sprinkling the germicide here and there is of little value. Disinfectants are most easily applied to the walls and ceilings with a spray pump or with a brush. As it is difficult to keep them from coming into contact with the face and hands, the mixtures least harmful to persons should generally be used.

In case of an actual outbreak of virulent disease it is advisable to use for disinfecting purposes a whitewash made by dissolving 1 pound of commercial lye (containing 94 percent of sodium hydroxide) and 2½ pounds of water-slaked lime in 5½ gallons of water. If the solution is not used at once, it should be tightly covered to prevent deterioration. This solution is cheap, odorless, and destructive to almost all kinds of disease germs. On prolonged contact, however, it may be injurious to painted or varnished surfaces, and to some fabrics. It is corrosive to aluminum, but relatively harmless to the metallic fixtures ordinarily found about chicken houses, and to wooden construction or equipment.

It is seldom necessary or practical to disinfect the soil. After removal of all birds the ground should be graded, holes filled, trash removed, and suitable drainage provided. This may be followed by a generous application of hydrated lime. While lime is not a very effective germ killer it does aid in checking their development by its drying action and also is effective in neutralizing odors and discourages the breeding of flies. All holes or passageways under buildings should be stopped up. This procedure, together with the action of sun and wind, destroys most disease-producing organisms which affect fowls within a matter of a few weeks in dry sunny weather.

For combating tuberculosis, the chicken houses, enclosed runs, and all eating, drinking, and other utensils should be thoroughly cleaned and disinfected with a strong solution of such germicides as carbolic acid or compound solution of cresol. Carbolic acid may be used in 5-percent solution and compound solution of cresol in 3-percent solution. Lye is not an effective disinfectant against this disease.

Kerosene emulsion is frequently used to destroy mites. To make the emulsion, shave half a pound of hard laundry soap into a half a gallon of soft water and boil the mixture until all the soap is dissolved; then remove it to a safe distance from the fire and stir into it at once, while still hot, 2 gallons of kerosene. This makes a thick, creamy emulsion or stock mixture. When it is to be used for killing mites in the houses, 1 quart of this emulsion is mixed with 10 quarts of water.

⁴ For further information see Farmers' Bulletin 1991, The Use of Disinfectants on the Farm.

The carbolineums advised for control of the common chicken mite and fowl tick are wood preservatives derived from coal tar. They should consist of pure anthracene oil. Creosote oil, advised as a spray for killing fleas, is also a coal-tar product used as a wood preservative. It should contain 10 to 15 percent of tar acids. These materials, especially creosote oil, are caustic and will stain; therefore, they should be used with care and should be allowed to dry into the wood thoroughly before fowls are allowed to enter the treated building.

See last page for precautions in handling disinfectants.

A further means of freeing premises from infection by most germs and parasites is to keep them free of fowls for several months, or a year if possible. Most disease organisms are destroyed if directly exposed to rays of the sun for a short time, and by this means fields and yards are eventually disinfected to a large extent. There are many dark or covered places not reached by the direct rays of the sun, however, and in such spots germs may survive for several months. *Coccidia* oocysts are not destroyed by disinfectants. It is advisable to place new stock on ground which has not been occupied by poultry for a year or more.

Dependence should not be placed upon the effectiveness of antiseptics when added to drinking water for the purpose of destroying disease germs since contamination of the water by feed, droppings, and mouth secretions soon destroys the germ-killing power of such disinfectants. Frequent changes of water or, if possible, running water, is more effective in controlling disease spread than the use of disinfectants in the water.

NUTRITIONAL DISEASES

NUTRITIONAL ROUP (VITAMIN A DEFICIENCY)

Nutritional roup is a disease of chickens and other poultry resembling infectious coryza, but is caused by a deficiency of vitamin A in the diet. It may appear in chickens of any age. The usual symptoms are lameness or a staggering gait in growing birds, and in mature stock a discharge from the nostrils, swelling beneath the eyes, and discharge from the eyes. Examination after death shows swollen follicles in the esophagus, pale kidneys, and, frequently, white accumulations of urates in the kidneys and ureters.

Treatment.—On being supplied with feeds containing vitamin A in sufficient quantities, poultry affected with nutritional roup usually recover. High-grade cod-liver oil is an excellent source of vitamin A. This vitamin may also be supplied satisfactorily in the form of commercial vitamin A concentrates of stated potency. Other good sources are fresh green feeds, alfalfa leaf meal, raw carrots, corn gluten meal, and yellow corn.

POLYNEURITIS (VITAMIN B₁ DEFICIENCY)

Polyneuritis is a condition that results from consuming a diet deficient in vitamin B₁. It may appear in birds of any age but growing birds are more susceptible than adults. This condition very seldom is observed in practice. The symptoms are loss of appetite, emacia-

tion, general weakness and inability to stand, and spasmodic movements of the head and limbs.

Treatment.—Treatment consists simply in feeding of whole grains and green feed. Since a satisfactory reserve of vitamin B₁ cannot be stored in the body it is important that it constitute a portion of the regular diet.

GIZZARD EROSION

The term "gizzard erosion" is used in referring to several abnormal conditions of the gizzard lining. In one condition there are one or more patches of threadlike, shallow fissures in the lining; in another there are small holes (sometimes referred to as dry ulcers) that usually contain blood debris; and in still another condition there is a softening and sloughing of portions of the lining. The first two conditions occur much more frequently than the third. The disease is most prevalent in chicks under 6 weeks old. The greatest incidence occurs during the first four days after hatching.

Cause.—The exact cause of gizzard erosion is not known. The most common type of gizzard erosion is preceded by hemorrhages from the capillaries in the submucosa. The reddish-brown spots and patches frequently found in the lining are the results of these hemorrhages.

Treatment.—When a well-balanced diet is fed, the reddish-brown spots disappear, then the patches, and finally the holes. The inclusion of one-tenth to one-half percent of dried ox bile in the diet hastens the disappearance of the erosions. Bile salts have a similar effect. There is some evidence that certain feedstuffs, such as alfalfa leaf meal, alfalfa meal, kale, bran, wheat middlings, or oats when included in the diet, tend to hasten the clearing up of the condition.

GOUT

Gout is caused by the presence of an abnormal quantity of uric acid in the blood, which results in the deposit of urates on the internal organs (visceral gout) or occasionally in the joints (articular gout).

Cause.—Some cases of gout result from vitamin A deficiency, but in other cases the exact cause of the excessive uric acid is not known. There is evidently some interference with the normal excretion of uric acid.

Symptoms.—In articular gout the joints of the feet and wings may be involved, with consequent lameness. At first the joints are swollen and painful. The lesions then form into nodular, tumorlike growths which may later burst, discharging a yellowish, turbid material containing urates. The bird remains sitting as much as possible. The general health becomes affected, and emaciation gradually occurs, with weakness and frequently diarrhea.

Visceral gout is apparent on autopsy only. The internal organs and serous membranes are found covered with chalklike deposits, particularly the heart and the inside of the heart sac. The kidneys and ureters are frequently swollen, pale, and engorged with urates. The course of the disease is slow.

Treatment.—Be sure that the diet is adequate with respect to all known nutrients, especially vitamin A. A reduction of the quantity of protein is sometimes recommended, and may be beneficial. It has been established, however, that the highest protein levels that could

possibly be achieved under practical conditions will not in themselves cause gout. Some authorities advocate the administration of saline purgatives, such as Carlsbad salt or Epsom salt, which may be followed by the daily administration of tincture of colchicum, two to five drops, to each affected fowl. In the articular form of the disease, the swellings about the enlarged joints may be opened and the contents washed out. The joint should then be dressed with a protective bandage.

RICKETS, OR RACHITIS (VITAMIN D DEFICIENCY)

Rickets (rachitis) is a disease of the bones of growing chickens that is most commonly caused by a dietary deficiency of vitamin D. It may be caused also by a marked deficiency of either calcium or phosphorus. The symptoms are poor growth, lameness accompanied by a stiff-legged gait, thickened leg bones and hock joints, and beading at the ends of the ribs. Spinal curvature and crooked breast bones also may be observed.

Treatment.—Permit the chicks to have access to sunlight, or include a vitamin D supplement in their diet, or do both. Commercial vitamin D supplements of guaranteed potency are available. In treating rickets, one should add 180 A. O. A. C. units⁵ of vitamin D per pound of all-mash diet. If the mash is to be fed with grain twice this quantity should be added. Direct sunlight, not through window glass, is also highly efficacious in preventing rickets. Glass substitutes that permit the passage of ultraviolet rays may be used. Glass substitutes, however, can be depended on only when they are kept clean. A thin film of dust on either side of the glass substitute prevents the passage of the effective rays just as completely as does ordinary window glass.

PEROSIS, OR DEFORMING LEG WEAKNESS (MANGANESE DEFICIENCY)

Perosis, also known as deforming leg weakness, slipped tendon, and hock disease is a condition that occurs among growing chicks as a result of a diet that is deficient in manganese. Perosis can be produced experimentally by making the diet deficient in choline, biotin, or nicotinic acid, but it is not believed that these deficiencies account for any of the cases observed in chickens under practical conditions. Choline deficiency may account for some cases observed in turkeys.

Symptoms.—The first symptoms noticed are a slight puffiness of the tissues about the tibiotarsal (hock) joint and discoloration due to subcutaneous hemorrhage. This stage is known as enlarged hocks, and if it does not go beyond this stage the bird may recover without permanent deformity. During this stage bending of the distal end of the tibia or the proximal end of the metatarsal bone may occur, which permits the Achilles tendon to slip from the condyles to either the inside or outside of the joint, causing the chick to lose control of the legs. Contraction of the tendon increases the deformity by further bending of the bones and causes permanent flexion of the leg so that the chick is unable to walk at all, and it sits or hops about on the hocks. This results in the bruising of the joint and frequently in the rupture of the synovial sac and joint infection.

⁵ This is the official unit of the Association of Official Agricultural Chemists.

Control.—Control consists in prevention rather than treatment as the disease cannot be cured after the resulting deformity has occurred. It is best controlled by making sure that the diet of the parent stock, as well as the diet of the chicks, contains about 50 parts of manganese per million parts. To insure that the diet contains an adequate quantity of manganese, it is suggested that a mixture of 100 pounds of common salt and 1.7 pounds of anhydrous manganous sulfate (or 2.2 pounds of manganous sulfate—tetrahydrate) be used in place of the salt in the feed. One-half percent of this mixture should be included in all-mash diets and 1 percent in growing and starting mashes, with which grain is to be fed. When used at these levels, this mixture of salt and manganous sulfate will supply about 30 parts of manganese per million parts of total feed. Since the feed itself will, in practically every case, supply at least 20 parts of manganese per million, the use of the salt mixture will insure the presence of at least 50 parts of manganese per million parts of feed.

AVIAN ENCEPHALOMALACIA, "CRAZY CHICK" DISEASE (VITAMIN E DEFICIENCY)

One form of so-called crazy-chick disease is the result of a deficiency of vitamin E (alpha-tocopherol) in the diet. This disease appears suddenly at an age between 2 and 4 weeks but seldom if ever after 8 weeks.

Symptoms.—When the chicks attempt to walk they often fall over and wheel in circles. In advanced cases there is frequently complete prostration with legs extended, the head retracted, and tremors of both head and legs.

Treatment.—Include 2 percent of corn oil, cottonseed oil, peanut oil, or soybean oil or 0.5 percent of wheat germ oil in the diet until the symptoms disappear.

An infectious disease known as epidemic tremor (infectious avian encephalomyelitis) presents somewhat similar symptoms. This disease is discussed under Diseases Caused by Filtrable Viruses.

CHICK DERMATOSIS (PANTOTHENIC ACID DEFICIENCY)

A dermatosis develops in chicks when their diet does not contain enough pantothenic acid, formerly known as the chick antidermatosis factor. The symptoms of a deficiency of this factor are sores and incrustations at the corners of the eyes and mouth, on the bottoms of the feet, and on the joints of the toes. Also the feathering is rough and there is a failure of growth.

Among the richest sources of pantothenic acid are yeast and liver. Feeds that are good sources are alfalfa, milk products, peanut meal, and wheat bran. Whole grains contain sufficiently large quantities of this vitamin so that deficiency is rare under practical conditions.

Dermatosis may be produced experimentally by making the diet deficient in biotin, but biotin deficiency is even more rare under practical conditions than is pantothenic acid deficiency. It may occur in turkey poults.

"CURLED TOE" PARALYSIS (RIBOFLAVIN DEFICIENCY)

In growing chicks a deficiency of riboflavin results in slow growth, decreased efficiency of feed utilization, and a twisted or flexed condition of the toes that is referred to as "curled toe" paralysis. In laying stock a deficiency of this vitamin causes the eggs to hatch poorly.

Good sources of riboflavin are fermentation byproducts, dried whey, dried skim milk, dried buttermilk, alfalfa leaf meal, and the better grades of fish meal and meat scrap. Synthetic riboflavin and various mixtures containing it are available commercially, and are usually sold with a guaranteed potency.

CANNIBALISM AND FEATHER PICKING

The term "cannibalism" is used by some poultrymen in referring to the habit sometimes developed by poultry of picking one another's feathers, toes, vents, combs, and other parts of the body. Used in this sense, the term includes feather picking, but it is more common to restrict its use to those cases where blood is drawn.

Cannibalism and feather picking probably originate from several causes, such as close confinement, idleness, dietary deficiencies, or the presence of itch mites at the base of the feathers. (See Depluming Scabies.) Experience has shown that it is good practice to allow as much room as possible for exercise and to provide a well-balanced diet. If mites are present, treat as for depluming scabies.

Treatment.—Feather picking, cannibalism, and related vices often can be stopped very quickly and easily by increasing the salt content of the diet for 2 or 3 days. If an all-mash diet is being fed, 2 percent of salt is added; but if both mash and grain are being fed, 4 percent of salt is added to the mash. In most cases the desired effect is obtained within a few hours after the salt is added to the diet, but it may be necessary to feed the extra salt for 2 or 3 days. This salt treatment is recommended for the cure but not for the prevention of feather picking and cannibalism. Ordinarily, it is not recommended that typical all-mash diets contain more than 0.5 to 0.7 percent of added salt or that mashes with which grain or a grain mixture is to be fed contain more than 1 to 1.2 percent of added salt.

If the salt treatment does not stop the feather picking or cannibalism within 3 days, it may be necessary to trim back to the quick the upper mandible of the beak of each chicken. This may be done with a sharp knife or a hot soldering iron. The trimming of the beak is painless, if it is done properly. Ordinarily, only about three-sixteenths of an inch of the tip of the beak is removed; the proper amount can be judged readily by the appearance of the beak substance.

INFECTIOUS AND CONTAGIOUS DISEASES

DISEASES CAUSED BY SPECIFIC GERMS

Apoplectiform Septicemia

Apoplectiform septicemia is a rapidly fatal disease of chickens, turkeys, pigeons, and other fowl which is caused by the germ *Streptococcus capsulatus gallinarum*.

Symptoms.—Symptoms may consist of depression, inappetence, listlessness, staggering gait, and finally prostration and death. However, the progress of the disease is so rapid that death may occur without noticeable symptoms.

Post mortem appearance.—There is usually a discoloration of the skin of the breast and neck caused by subcutaneous hemorrhages. Serous or bloody exudates may be seen in the heart sac and body cavity. The liver, spleen, and kidneys, may be greatly swollen, and in addition a false membrane may be spread over the surface of the liver. The intestines are thickened and congested, with bloody contents. The lungs may be congested or pneumonic.

Control.—Observe the sanitary precautions outlined early in this bulletin. Healthy fowls may be successfully vaccinated against apoplectiform septicemia by the intravenous injection of a killed culture of the causative organism.

Fowl Cholera

Fowl cholera is a contagious disease affecting practically all classes and ages of fowls. It generally occurs as an acute septicemia causing high mortality but may assume a chronic form and last for months, only occasionally killing a bird.

In very acute cases no symptoms are seen; the birds may be found dead under the roosts, or they may fall while feeding or moving about and die in a short time. During an acute outbreak sickness is seldom noticed more than 24 hours before death, which usually occurs within 3 days of the time of infection.

Cholera may destroy the greater part of a flock in a week and then disappear, or it may linger in a chronic form for months, only occasionally killing a bird. The chronic form is characterized by a continually increasing weakness, loss of weight, paleness of head, and finally an exhausting diarrhea. Sometimes one or more joints of the wings or legs swell, the bird becomes lame, and later the swellings break and discharge a creamy or cheesy mass. Swollen wattles are more or less prevalent in some outbreaks. These are characterized by the formation of accumulations of cheesy pus in the wattles caused by localized infection with the fowl cholera germ.

Post mortem appearance.—The heart has red spots or hemorrhages on its surface. The first portion of the intestines is congested and hemorrhagic, and the contents consist of a pasty mass, which may be bloodstained. The vessels of the visceral organs are congested. The liver may be enlarged and darker in color and the spleen may be swollen. A sticky fluid is frequently present in the mouth and nostrils.

Control measures.—Since medicinal treatment of affected birds is unsatisfactory, the aim should be to prevent, so far as possible, the spread of infection. The first fowls showing acute feverish symptoms should be destroyed by a method which will guard against the contamination of the premises by infected blood. The carcasses should be burned or buried deeply. The healthy fowls should be moved to new quarters, if possible, and carefully watched for signs of the disease. The house and runways should be cleaned and disinfected as outlined under Disinfectants and their Application.

There are no drugs or treatment for fowl cholera which can be recommended without reservations. Some of the sulfonamid drugs

are being used to help control fowl cholera, but their efficacy varies in different outbreaks and they lower the mortality rate only temporarily. A scheme of intermittent treatment may be effective in holding mortality in check. It should also be emphasized that these drugs are toxic to chickens and should be used with caution.

Fowl Typhoid

Fowl typhoid is an acute infectious disease of fowls caused by a germ, *Salmonella gallinarum*. Chickens, turkeys, and guinea fowls are susceptible, but ducks, geese, and pigeons are somewhat more resistant. Some wild birds are also susceptible. The causative organism of this disease, *Salmonella gallinarum*, belongs to the same group as *Salmonella pullorum*, the causative organism of pullorum disease. These organisms have much in common. They cross-agglutinate, i. e., a pullorum antigen will detect both pullorum and typhoid-infected birds by means of the agglutination test. These two organisms are difficult to distinguish except by a biochemical test.

Symptoms.—There are no outstanding symptoms in this disease by which it may be definitely diagnosed. As in other acute infectious diseases there is depression, lack of appetite but increased thirst. A pale orange colored diarrhea might be said to be characteristic. The comb is often pale and shrunken.

Post mortem appearance.—In very acute rapidly fatal cases there may be little or no change in the organs, but the liver is usually much enlarged (fig. 1) and of a brick-red color. The spleen and kidneys are also greatly swollen and dark red. Later in an outbreak the liver may be greenish-bronze or mahogany colored, and pin point gray spots may be seen on its surface. The ova are frequently flaccid and sometimes ruptured. In chronic cases gray nodules may be seen on the heart and sometimes on the intestines. In young chicks the liver, spleen and kidneys are swollen and dark red.

How the disease is spread.—Fowl typhoid may be spread by man, animals, or equipment if these agents are contaminated by manure, dirt, feed, or water in which the germ can survive. The disease may thereby be carried from pen to pen and from house to house, or possibly from farm to farm.

However, the bird infected with fowl typhoid is by far the most dangerous spreader of the disease because in the acute stage millions of highly virulent germs are given off constantly from the mouth and nostrils as well as through the droppings, thus contaminating the feed, water, and litter very rapidly. Hence prompt segregation of the sick from the healthy birds is indicated.

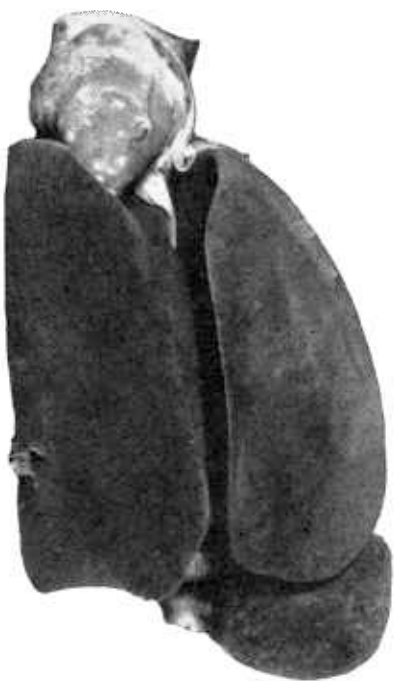
The most important perpetuator of fowl typhoid, as in pullorum disease, is the carrier bird. In almost any outbreak of disease there are some survivors, and in the case of fowl typhoid as well as pullorum diseases many of these survivors become carriers. The germ localizes in the ova, and a variable percentage of eggs laid will be infected, often resulting in an outbreak of fowl typhoid when such eggs hatch. Carrier pullets may lay infected eggs on the range or in hen house. If some of these eggs get broken and are eaten by other pullets, an outbreak may start.

Since the bird dead of fowl typhoid is such a dangerous source of diseases, it should be buried or burned promptly and effectively to prevent animals and insects from coming in contact with it.

Animals that may spread the disease by mechanically carrying contaminated material on or in their bodies include rats, and other predatory or scavenger wild animals, buzzards, and possibly other free-flying birds. Flies and other insects may also be involved in the spread of the disease.

Control.—Control procedures to be employed depend somewhat on the age of the birds and the purpose for which they are maintained. As in many other poultry diseases, the best control procedure is prevention. All eggs for hatching or baby chicks should be obtained from typhoid-free flocks.

When an outbreak occurs in large breeding flocks the pen or portion of the flock affected should be shut off from the remainder of the flock, and every practical sanitary precaution should be taken to prevent spread of the disease to healthy birds. The following procedures may aid in controlling the spread of the disease: (1) Separate the normal birds from the sick. (2) Attend to the sick birds last. (3) Disinfect footwear, hands, and utensils after attending to the sick birds. (4) Prevent contamination of feed and water by providing grilled covers, and change water often. (5) Give feed in small amounts so as to prevent waste and ground feeding. (6) Scatter hydrated lime liberally over litter, or spray with a solution of a cresylic or other coal-tar disinfectant to discourage picking at droppings and spilled feed.



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FIGURE 1.—Heart, liver, and spleen of a chicken affected with sub-acute fowl typhoid. Note enlarged liver and spleen and white spots on heart, all of which are typical symptoms of the disease.

Within 1 to 2 weeks after the outbreak has subsided, all birds should be tested by the agglutination test and all reactors removed. This test should be repeated at 30-day intervals until no more reactors are found. In small flocks the easiest method of control is the destruction of the entire flock.

In a broiler flock the same sanitary precautions should be taken in an outbreak as outlined for a breeding flock. If the flock is near marketing age the unaffected portion should be disposed of if it appears that the outbreak cannot be controlled.

There are no drugs or treatment for fowl typhoid which can be recommended without reservations. Some of the sulfonamid drugs are being used to help control fowl typhoid but they lower the mor-

tality rate only temporarily, i. e., they give relief rather than cure, and a scheme of intermittent treatment may be necessary to hold the mortality in check. It should also be emphasized that these drugs are toxic to chickens and should be used with caution.

Infectious coryza (Rhinitis, Roup, Cold)

Infectious coryza is an infectious and contagious disease of chickens and other species of fowl which spreads rapidly through poultry flocks, attended by variable mortality.

Cause.—The disease, as recognized in chickens, is caused primarily by the germ *Hemophilus gallinarum*. There is no doubt, however, that the condition is aggravated and prolonged in some cases by secondary invasion by certain pus-producing organisms. Exposure to unfavorable living conditions also tends to lower the fowl's resistance to respiratory infection.

The cause of related diseases in other species of birds has not been definitely determined.

Symptoms.—The principal symptoms of infectious coryza are a bloody or mucous exudate in the nasal passages and sinuses usually accompanied by mouth-breathing. An offensive odor is frequently present. The inflammation soon extends to the eyes, causing swelling and redness of the membranes, and a foamy lachrymation. This tends to dry and stick the eyelids together. Some cases develop more or less swelling of the sinuses below the eye, due to



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FIGURE 2.—Head of fowl affected with coryza, showing swelling of the eye.

impaction with cheesy pus, the pressure of which may eventually destroy the eye or cause loss of vision (fig. 2). Others manifest a generalized edema of the region of the head and neck. There is initial fever, loss of appetite, weakness, and sometimes coma and death. During the progress of these symptoms the obstruction of the air passages with exudates causes difficult respiration, accompanied by loud breathing.

In severe and advanced cases the birds sit in a drowsy, or semi-conscious condition, unable to see or eat; their strength is rapidly exhausted, and many of them die within a week or 10 days. Some of the affected birds recover, but others remain weak and have a chronic form of the disease for months.

This disease is distinguished from diphtheria (fowl pox) by the absence of the thick, tough, and very adherent cheesy exudates in the mouth and throat which are characteristic of diphtheria. Sometimes, there may be a deposit of yellowish material on the walls of the

mouth and throat, but it is easily broken up and removed. There are no warts on the comb, face, or wattles.

If mouth breathing is long-continued, it eventually brings about a horny, dried condition of the tip of the tongue, commonly called "pip." This may be prevented by applying petrolatum to the tongue.

Treatment.—It is doubtful if individual topical treatment of fowls is worth while in outbreaks of fowl coryza. However, if it is desirable to treat some of the best birds they should first be removed from the flock and put in a warm, dry, well-ventilated room which is free from drafts. Mild antiseptics such as boric acid, hydrogen peroxide, 15-percent argyrol, or 4-percent silver nitrate may be used to clean the nasal passages and eyes.

In chronic cases where the sight is seriously impaired the bird had better be destroyed.

"SWELL HEAD," OR SINUSITIS, OF TURKEYS

"Swell head" is a condition manifested by the filling of the sinuses of the head of turkeys with exudates of a more or less fluid consistency. It may run a chronic course in a flock, persisting at times for a number of weeks.

Cause.—This condition is believed to be of infectious origin, although the cause is not definitely known. In some respects it is considered somewhat similar to infectious coryza. Similar manifestations may also follow a deficiency of vitamin A. (See Nutritional Roup.)

Symptoms.—At first the birds shake their heads to dislodge the nasal exudates. Later foamy lachrimation appears in the eyes, after which the eyes partly or completely close, and the sinuses swell. Loss of vision and inability to eat cause the birds to lose weight rapidly. Difficult breathing may be observed also. Some deaths in the flock may occur from emaciation or pneumonia.

Treatment.—The Utah Experiment Station has reported the following treatment for the early stages of swell head of turkeys to be effective: First withdraw the fluid from the sinus by means of a glass syringe and an 18-gage needle, after which the syringe may be detached and the needle left in position. The exudate is emptied into a receptacle of disinfectant. A second syringe is then filled with a 4-percent solution of silver nitrate, of which 1 cc. is injected into the sinus and worked through the tissues by gentle massage. In severe cases the treatment may be repeated.

Preventive measures should be taken to protect the flock from exposure to drafts or windstorm, and the diet should be fortified with adequate amounts of vitamin A as there is little doubt that a diet deficient in vitamin A will predispose turkeys to this disease.

Paratyphoid Infection (Salmonellosis)

Paratyphoid infection (Salmonellosis) is a septicemic disease of fowls including turkeys, pigeons, chickens, ducks, geese, pheasants, quail, and some free-flying species of birds. It is primarily a disease of young birds in which mortality may vary from 20 to 80 percent. The economic importance of the disease in domestic fowl is in the order in which they are mentioned above.

The *Salmonella* group comprises a large and growing list of species. Of approximately 150 species of *Salmonella* so far isolated from man and animals, 47 have been found in fowls. Several species of *Salmonella* have been recovered from powdered whole egg, and these organisms have been implicated in food poisoning in man. *Salmonella pullorum* and *Salmonella gallinarum*, the causative organisms of pullorum disease and fowl typhoid, respectively, are also included in this group.

Young turkeys that are affected frequently huddle close to the brooder stove. They manifest weakness, droopiness, stunted growth, inappetence, and in some cases bowel disturbance. Grown birds may show emaciation, inappetence, and a general unthrifty appearance. Death may occur without preliminary symptoms in the young, but older birds may succumb after being affected several days. At autopsy, fluid may be found in the heart sac, and a hard plug or cast may be present in the blind gut.

In grown pigeons the infection may be manifested by the formation of abscesses, particularly affecting the wings and rendering flying difficult if not impossible. Recovery may occur without treatment, and flying may be resumed. Affected squabs may show nervous symptoms, such as shaking of the head, staggering, and leg weakness. Carrier birds may harbor the infection in their lungs.

In chicks and ducklings the symptoms are somewhat similar to those of pullorum disease, the affected birds being weak, listless, and inclined to stay near the hover. Chronic cases become weak, droopy, and unthrifty.

Transmission.—Birds that have recovered from an attack of the disease may become carriers in which the organism may locate in the ovary, in the intestinal tract, or in other organs. Thus the disease may be transmitted through the egg, or may be discharged with the droppings. When eggs are soiled by droppings from infected birds the organism may penetrate the shell and infect the contents. While the principal means of transmission of pullorum disease and fowl typhoid is through the egg, the causative organisms have also been found in the intestinal tract, but it has not been demonstrated that they are capable of penetrating the shell.

In pigeons the disease is believed to be transmitted primarily by the infected secretions of the mouth during bill feeding of the young.

Control.—The disease must be prevented largely by obtaining stock from uninfected sources.

While the agglutination test will remove some reactors, it is of limited value since there are numerous species of *Salmonella* organisms and each requires a separate antigen for its detection. Sanitation as discussed for the general prevention and control of diseases is recommended as an aid in the control of this infection.

Pullorum Disease

Pullorum disease (formerly called bacillary white diarrhea) is widespread, existing in every section of the United States where appreciable numbers of poultry are kept. It causes heavy financial losses, resulting from the death of baby chicks, diminished egg production in hens and pullets, reduced hatchability of eggs, and occasionally the

death of hens due to generalized pullorum infection. The disease also causes, in some sections, heavy loss in turkey poults. The cause of the disease, methods of transmission, detection, and control are the same for chickens and turkeys. The following discussion of the disease in chickens therefore applies also to the disease in turkeys. Natural infection has also been observed in ducks and guinea fowl.

Cause.—The disease is caused by a germ which is known as *Salmonella pullorum*. Although this germ is quite easily destroyed by direct sunlight, heat, or disinfectants, it has been known to remain alive in soil or manure in sheltered places for many days, or even months. The primary seat of pullorum infection is the ovary of the infected hen.

A new problem in pullorum disease control was introduced with the discovery by a Canadian investigator⁶ in 1940 that the causative organism, *S. pullorum*, may vary in its antigenic make-up so that the standard antigen, either tube or plate, will no longer detect all the infected birds in a flock where the infection is due to the variant type. This *Variant* strain of the pullorum organism is so widespread in Canada that an antigen prepared from a variant strain of pullorum must be used in all agglutination testing for the detection of pullorum disease. For the rapid whole-blood test a polyvalent antigen containing both standard and variant strains is used but these strains cannot be mixed in the tube test, so two tube tests must be made of all blood samples so tested, one containing standard antigen and the other variant antigen. The variant form of the disease was first positively identified in this country from the Midwest early in 1947, and since that time several States in that area have encountered a considerable amount of the variant type of infection. The variant type of pullorum infection is more often found in pullets. When losses from pullorum disease are experienced in chicks from flocks in which no reactors are found upon testing with the standard antigen one should suspect variant-type infection and retest the flock with a polyvalent or variant-type antigen.

Mode of dissemination.—The disease is commonly transmitted from the hen to the chick by means of the egg (fig. 3). All eggs laid by an infected or "carrier" hen do not contain the organism *Salmonella pullorum*, but infected eggs, if hatched, produce infected chicks. Such chicks may die of the disease any time during the first 3 weeks of their lives, or they may survive to maturity and repeat the cycle (fig. 4) by themselves producing eggs and chicks infected with the organism. Chicks having the disease are constantly voiding enormous numbers of the germs in their droppings, thereby spreading the infection. The hatching of infected eggs in an incubator or under a hen may result in the transmission of the disease to other chicks hatched from uninfected eggs in the same incubator or brood. Infected chicks placed in a brooder house with healthy chicks will spread the disease. In the case of the hatchery chicks, however, the danger of acquiring the disease is multiplied by the fact that the eggs for hatching are frequently assembled from a number of flocks, and if one or more of these flocks happen to be harboring the infection, the entire output of the incubator is exposed to the menace of the

⁶ Younie, A. R., Canadian Jour. Comp. Med. 5: 164, 1941.

disease. Progressive hatcherymen have long realized the necessity of protecting their customers from outbreaks of pullorum disease in chicks. For this purpose, flocks which supply eggs for hatching are required by the hatcheryman to be tested for the presence of pullorum disease carriers and he also requires that supply flocks be maintained under sanitary conditions. The control and eradication of pullorum disease has been greatly advanced by such measures, particularly in flocks participating in the National Poultry Improvement Plan, one of the chief objectives of which is the control and eradication of pullorum disease.

Symptoms.—In hens and pullets pullorum disease is limited as a rule to the egg-making organs, and consequently produces no outward symptoms. It may, therefore, exist unsuspected in a flock. In chicks the symptoms of the disease and the deaths which it causes are sometimes wrongly attributed to some other cause, such as fungus pneumonia (aspergillosis), chilling, or overheating. In order to diagnose definitely the disease in chicks, clinical observations must be confirmed by bacteriological examination.

Pullorum disease is observed in chicks from the time of hatching until they are about 3 weeks old. The chicks may die suddenly after having shown but slight symptoms for a short time. Generally, however, they will first seem disposed to huddle together, or remain too much of the time under the hen or the hover. They soon appear drowsy and indifferent to their surroundings. They stand about with closed eyes and ruffled plumage, listlessly picking at their feed from time to time, but apparently not eating it. Their droppings may be whitish, foamy, and sticky, or sometimes brownish in color. Hence the name "bacillary diarrhea" is in some cases an inaccurate description of the disease. Sometimes the excrement sticks to the down in the region about the vent and accumulates until it completely covers and plugs the opening. This condition, known as "pasting up behind," unless soon relieved, will quickly cause the death of the chick. When attempting to void the excrement sick chicks utter shrill cries of pain. Labored breathing signals the approach of death, which may then come quickly, or after a period of extreme prostration. The death rate in infected broods may range from 50 to 80 percent.

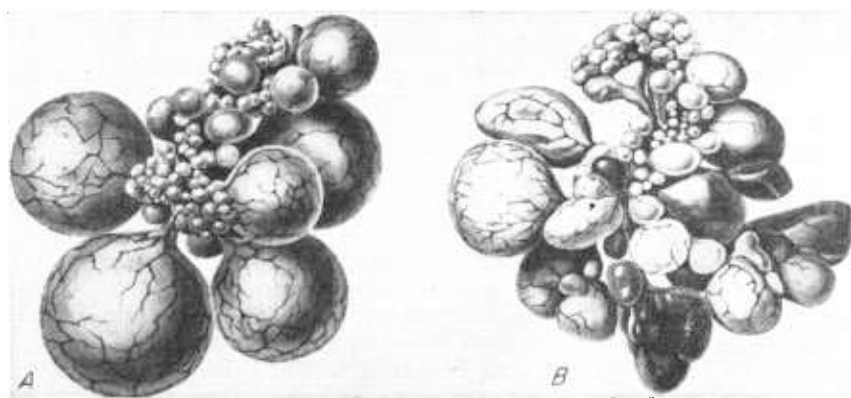
Post-mortem appearance.—In hens and pullets the outstanding change brought about by the disease is that seen in the ovary. In making an autopsy of fowls that have died, or when preparing fowls for the table, the ovaries should be examined for lesions of pullorum disease. In an infected ovary the partially or wholly developed yolks are angular in outline, shrunken, hard, and of an abnormal brownish or greenish color (fig. 3, b). At times yolks containing dark fluid are observed. The presence of *Salmonella pullorum* in the diseased ova can usually be determined by laboratory methods.

In chicks dead from pullorum disease the presence of noticeable changes depends somewhat upon the age of the chick at death. Those from 1 to 5 days of age often fail to show visible internal evidences of the disease. Chicks dying at 6 days of age and upward very often show small necrotic spots, like whitish deposits, in the lungs, in the muscles of the heart, and possibly on the outer surface of the intestines. The absence of any pathological changes on autopsy does not, however, mean that the disease is not present. The germs some-

times inhabit practically every organ in the chick's body, but they are most frequently recovered from the heart, liver, lungs, the unabsorbed portions of yolk, and from the blood. Determining the presence of this infection in fowls of any age requires special training as well as the use of equipment and materials not generally available outside the laboratory. It is usually possible to have an expert examination made of suspected cases of pullorum disease at any of the State agricultural experiment stations.

Methods of diagnosis of pullorum disease.—Various methods have been developed for the detection of carriers of pullorum disease in flocks (fig. 4). The decision as to which method shall be adopted in a given case will depend largely upon the kind of service available.

The agglutination test.—Three different forms of the agglutination test are in use at the present time: (1) The long method, or tube test, (2) the rapid serum method, and (3) the rapid whole-blood



26321-B

FIGURE 3.—*a*, Normal ovary of fowl; *b*, ovary affected with *Salmonella pullorum*. (After Rettger.)

method.⁷ For practical purposes these three methods may be considered equally reliable for the detection of pullorum-disease carriers.

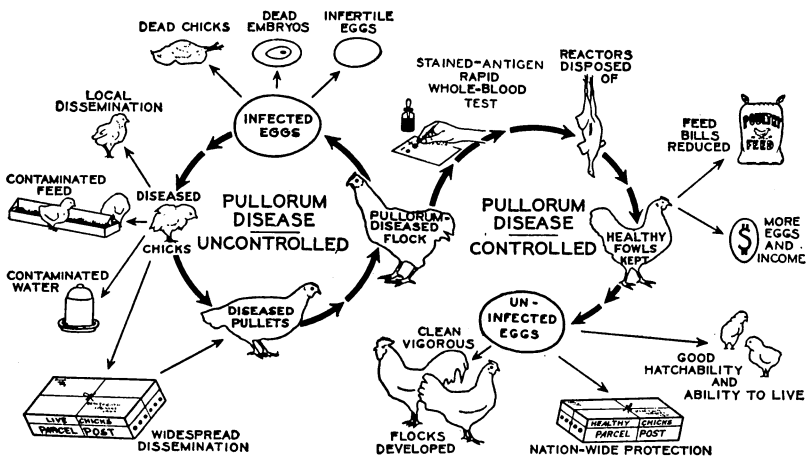
The long method, or tube test.—This method of testing is strictly a laboratory procedure and is not adaptable to field use. A small sample of blood is collected from each fowl to be tested, and the clear serum is allowed to separate from the clot. A proportionate amount of the serum is mixed with an antigen consisting of a standardized suspension of *Salmonella pullorum* organisms. After thorough agitation the mixture is incubated for 1 to 2 days, and finally examined for the presence of an agglutination reaction, which is manifested by the clearing of the fluid and clumping of the bacteria in the bottom of the test tube, indicating that the hen is infected with the germ of pullorum disease. In negative cases there is no clearing of the mixture, and no clumping of the bacteria.

It is generally agreed among poultry-disease workers that the tube

⁷ The rapid whole-blood test is more fully discussed in Miscellaneous Publication 349, Use of the Rapid Whole-Blood Test for Pullorum Disease, issued by the U. S. Department of Agriculture.

agglutination test is the most accurate method for detecting carriers of pullorum disease in turkey breeding flocks.

The rapid serum test.—Although this method is essentially a laboratory procedure, it may, with certain modifications, be made adaptable to field use. With this method the undiluted clear serum of the fowl to be tested is mixed with a highly concentrated antigen on a glass plate or slide, over an illuminated dark background. The antigen employed is a standardized suspension of *Salmonella pullorum* in a concentrated solution of sodium chloride preserved with phenol. For the test, a pane of glass forms the top of a black-lined box illuminated by a frosted incandescent bulb within. The two substances are mixed by the aid of a toothpick. The reaction may occur immediately or may require several minutes. A positive reaction consists in the for-



71056-B

FIGURE 4.—Graphic comparison of serious effects of uncontrolled pullorum disease with the benefits resulting from the use of the agglutination test and the disposal of reactors.

mation of visible clumps of the bacteria and a clearing of the intervening fluid. A negative test remains uniformly cloudy, without any clumps forming.

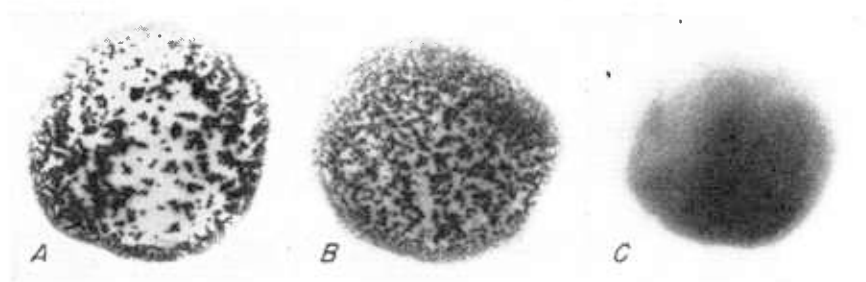
The rapid, whole-blood test.—This test is somewhat similar in its mechanism to the rapid serum test previously described, but owing to its simplicity and facility of operation, it is well adapted to field use. Outstanding advantages of the rapid, whole-blood test are as follows: (1) The use of a single drop of fresh, whole blood immediately after it is obtained from the fowl; (2) the colored antigen, which makes it easy to detect reacting cases over a white background; and (3) the fact that the presence or absence of pullorum infection is immediately diagnosed with one handling of the fowl, and reactors are disposed of at the time of the test, eliminating the necessity of banding the fowls.

The antigen for the rapid, whole-blood test is composed of a heavy suspension of killed *Salmonella pullorum* in physiological saline solution preserved with formalin and colored with dye.

In the application of this test a drop of blood is obtained by pricking

the wing vein with a sharp-pointed instrument. The drop of blood is picked up with a wire loop and immediately mixed with one drop of stained antigen on the test glass or plate. The antigen is placed on the glass first, and the drop of blood is added to it. With the same wire loop, the antigen-blood mixture is stirred for a moment and then spread out on the glass to a diameter of about 1 inch. When the glass is rocked from side to side a few times, over a sheet of plain paper or other white background, the agglutination usually becomes visible in from 5 seconds to 2 minutes in reacting cases. In negative cases it remains uniformly turbid (fig. 5). Following each test, the loop is rinsed in clean water and dried on a clean towel in preparation for the next test.

Control.⁸—The sulfa drugs have been reported as successfully used to prevent death losses in chicks from pullorum disease. However the use of the drug should be limited to the treatment of chicks being reared for market. Following treatment many of the birds will remain



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FIGURE 5.—Reactions to the stained-antigen rapid, whole-blood agglutination test for pullorum disease: A, A strong positive reaction; B, a medium positive reaction; C, a negative reaction.

permanent carriers and should never be used for breeders. In the breeding flock the only practical means for controlling pullorum disease is to detect the carriers by the blood test and eliminate them from the flock.

Hatchery sanitation in the control of pullorum disease.—Incubators may be disinfected, when not in use, by the following method:

Egg trays, nursery trays, and other readily removable parts should be taken out and scrubbed with a 2-percent commercial-lye solution.

Chick down, droppings, and shell fragments should be removed from the incubator with a brush or vacuum cleaner, and the interior of the machine should be sprayed with a 5-percent formalin solution. The incubator should then be left closed for at least 2 hours to permit the formaldehyde gas to penetrate to all parts of the apparatus.

Fumigation of the incubator room may be accomplished by wetting thoroughly the exposed surfaces with a 5-percent solution of formalin and then leaving the room closed for 12 hours at a temperature not below 60° F.⁹

⁸The control of pullorum disease in connection with the National Poultry Improvement Plan is discussed in Miscellaneous Publication No. 300, The National Poultry Improvement Plan.

⁹A more detailed discussion of incubator fumigation is given in Miscellaneous Publication 349, Use of the Rapid Whole Blood Test for Pullorum Disease.

Chick brooders and brooder rooms, when not in use, may be disinfected in a similar manner.

Tuberculosis

Fowl tuberculosis is a chronic infectious disease of domestic and wild birds. It is most common, however, in the chicken and pigeon. It is readily contracted by pigs, rats, and mice, but man is rarely affected by fowl tuberculosis. Parrots and canaries are quite susceptible to human tuberculosis, but fowls are practically insusceptible.

Cause.—The disease is caused by *Mycobacterium tuberculosis avium*. Tuberculosis is generally brought into the poultry yard with fowls that are purchased from infected flocks. If the disease exists in neighboring flocks the contagion may be carried by small birds, animals, or persons passing from one yard to another. A peculiarity of tuberculosis of birds is that the liver and intestines are nearly always very severely affected, and that as a consequence the organisms are very numerous in the intestinal contents and are scattered with the droppings. The introduction of a single diseased bird, therefore, may cause the infection of the greater part of the flock in a few weeks. In the same way, when wild birds contract the disease, the germs are carried and deposited in yards which they visit.

Pigs, rats, and mice are especially liable to be infected with fowl tuberculosis by eating the carcasses of birds which have died of it, and these animals serve to keep up the contagion and may communicate it to other fowls, especially if the latter eat the carcasses of rats or mice that have died of the disease.

Symptoms.—Although birds may become infected at any age, the disease usually progresses slowly, and symptoms are generally not observed until the affection has reached an advanced stage. Hence it is the older fowls, those more than 1 year of age, which display the most pronounced symptoms and show a high death rate.

Signs of disease begin with gradual loss of weight, wasting of the muscles, especially noticeable in the breast, paleness of the comb, and toward the end, dullness, sleepiness, and diarrhea with yellowish or greenish droppings. Very often there is at the same time a tuberculous inflammation of the joints and of the sheaths of tendons, which is revealed by lameness and swelling of the joints and legs. Occasionally the skin over the swollen joint breaks, the interior of the joint is ulcerated, and a small quantity of cheesy material is discharged. Deaths in the flock occur at intervals. Affected birds may live only a short time after symptoms are noticed, or they may live for weeks.

Post mortem appearance.—On post mortem examination grayish-white or yellowish tumors of varying sizes are observed in the internal organs, but especially in the liver (fig. 6), spleen, and intestines. These tubercles when cut open present a solid, grayish, glistening interior which in the larger ones, exhibits yellowish centers or a number of yellowish points. Those of more advanced growth show extensive yellowish, cheesy or crumbly masses in their interior.

Distinguishing tuberculosis from other diseases.—The diseases which may be confused with tuberculosis of birds by similarity of lesions are: Tumors or cancers of the abdominal organs, tapeworm nodules in the intestine, fungus condition of the lungs, blackhead of

turkeys, blood poisoning which produces an enlarged, spotted liver, leukemia (big-liver disease), or gouty swelling of the joints. These diseases are described elsewhere in this bulletin. The prominent lesions of the conditions mentioned are usually limited, however, to certain specific organs instead of being spread to the variety of organs attacked in tuberculosis. A definite diagnosis may be had in all cases by microscopic examination of the disease processes. Avian tubercles



444-11

FIGURE 6.—Tuberculous organs of fowls. Note spots on liver and its greatly enlarged condition.

contain extremely numerous tuberculosis organisms which are readily seen in laboratory examination.

Testing fowls for tuberculosis.—Diagnosing tuberculosis in living fowls is possible by means of the intradermic tuberculin test. The test fluid used is prepared from culture medium in which avian tubercle bacilli have grown for 8 weeks or more. The fluid must be injected, by means of a small-caliber syringe with a 26- or 27-gage needle, into the deeper layer of the skin of the wattle. Slightly less than 1 drop, about one-twentieth of a cubic centimeter, is forced into the skin just beneath the surface, and not deep enough to penetrate the skin or enter the underlying connective tissue of the wattle. Only one wattle is injected, the other being left for comparison. Forty-eight hours after the injection, a swelling in the wattle indicates a positive reaction and the presence of tuberculosis in the fowl (fig. 7).

The presence of tuberculous fowls in a flock may be detected by this test, which should be applied by a veterinarian.

Prevention and eradication.—No treatment will cure tuberculous birds. The most thorough method of eradication is to slaughter the entire flock when indications point to an extensive outbreak. Fowls in good flesh, showing no lesions or slight ones, may be used for food, provided all affected organs and parts are removed and the meat is thoroughly cooked. Those badly diseased and all visceral organs of the others should be destroyed.

The chicken houses, enclosed runs, and all eating, drinking, and other utensils should be thoroughly cleaned and disinfected as previously specified. After disinfection the premises should be kept free of fowls for a year. New stock should be placed on ground which has not been occupied by poultry for a year or more. Obtain birds or eggs for hatching from flocks which are free from infectious diseases. When the breeding value of the fowls makes it undesirable to dispose of the entire flock by slaughter, tuberculosis may be controlled and even totally eradicated by supplementing the customary culling measures with the tuberculin test and sanitation. As has been stated, the disease develops very slowly, and for that reason it is advisable to dispose of birds when they reach the age of 18 months, or at the end of the first laying period. From an economic standpoint also, except possibly in the case of breeding stock, this is sound policy, as the egg yield decreases after the first year of laying. Younger birds should be disposed of whenever they appear to be abnormal. This procedure alone will greatly assist in holding tuberculosis in check.



22304-C

FIGURE 7.—Fowl showing swollen wattle, following tuberculin test, indicating the presence of tuberculosis.

DISEASES CAUSED BY FILTRABLE VIRUSES

Avian Leukosis Complex (Fowl Paralysis)

Fowl paralysis, also called lymphomatosis and leukosis, is a complex disease having several manifestations and affecting chickens and, to a limited extent, turkeys and pheasants. The disease may manifest itself by paralysis of the limbs, "gray eye" and blindness, tumor formation, and leukemia.

A great deal of investigational work has been done and is being done on this disease, but as yet complete information on the cause, methods of spread, and control is not available.

Susceptibility.—All breeds are about equally susceptible, but there is a great variation in the susceptibility of different strains and of individuals within the strain. Thus, there are strains of fowls dis-

tinctly resistant or susceptible to fowl paralysis, and either of these characteristics may be transmitted to the offspring.

Baby chicks seem to be most susceptible to artificial infection. This susceptibility decreases, however, with age. In natural outbreaks the disease occurs in birds from 6 weeks of age to over a year old, the greatest losses occurring between 4 and 8 months of age.

Although baby chicks are most susceptible to the disease, the greatest losses occur in the older birds because of the incubation period of 2 months or more. Although only one or two birds come down at a time, it is a continuing occurrence, and over a period of a year losses may mount to 50 percent of the flock or more.

Cause.—The disease may be reproduced experimentally in susceptible birds by a filtrable virus. Whether or not other agents or conditions such as diet, management, and parasites play an important role in causing the disease has not been fully investigated.

Symptoms.—There is at present no method of diagnosing the disease in live birds which will eliminate all the birds that may be carrying the agent causing the disease.

Two manifestations of the disease are commonly seen, paralysis of the limbs and gray eye. Perhaps the most common and most striking type is that in which the nerves to the legs or wings are affected, with resulting lameness or drooping of the wings. In acute cases in young birds on the range the onset may be sudden, the first noticeable symptom being a slight limp. The lameness usually becomes progressively worse so that the bird becomes prostrated in a few days. Paralysis of the limbs is usually not complete, and the bird, although unable to stand, may still be able to kick when disturbed. A characteristic posture in the later stages of the disease is one in which the bird lies on the breast with one leg extended forward and the other backward. Either one or both legs or wings may be affected. In cases in which the wing is dropped, enlargement of the wing nerve may sometimes be noted at the point where it crosses the radius bone on the inside of the wing at the elbow joint.

Other less common symptoms of involvement of the nervous system are (1) torticollis, or spasm of the neck muscles causing the head to be drawn to either side, down between the legs, or straight back with the beak pointing up, and (2) incoordination, varying from a slightly weaving gait to falling or turning somersaults.

In gray eye there is a loss of the bay color in the iris (fig. 8) ranging from a narrow pale ring around the margin of the pupil to total grayness of the iris, when the eye often presents a glassy appearance. In advanced cases, the pupils frequently become irregular in outline, very small, or eccentric, and there may be bulging of the eyeballs. In advanced gray eye there is generally partial or complete blindness. Some birds with gray eye appear to be otherwise healthy and may lay fairly well. Gray eye is more often seen in mature birds.

Other symptoms of disease sometimes associated with paralysis outbreaks are skin tumors and anemia.

Skin tumors may be small and almost as numerous as the feather follicles, or there may be only a few large ones (1 inch or more in diameter), the centers of which are generally necrotic and discharging.

Anemia may be recognized by the extreme pallor of the head or by microscopic examination of the blood. If it is a true leukemia, the leu-

cocytes, or immature blood cells, will be present in the blood in large numbers. This is the only type of the fowl-paralysis complex in which there is obvious alteration of the blood picture.

Acute attacks may terminate fatally in a few days, whereas birds affected with the chronic form of the disease may live for weeks or months; a few appear to recover.

Post mortem appearance.—On autopsy of the paralyzed fowls it will be noticed that the nerve supplying the affected limb is swollen (fig. 10). The part of the nerve in which the swelling is most prominent is generally the first inch after its emergence from the spinal column, though sometimes the swelling is apparent all the way down the leg or wing to the nerve ending. It is usually necessary to remove

the overlying kidney to observe the enlargement of the lumbosacral nerve plexus. The vagus nerves (fig. 9, *cc*), supplying the heart, lungs, and digestive tract, may show only spindle-shaped swellings just anterior to the heart, or uniform enlargement all the way to the head.

In the acute form of the disease which attacks young birds on the range the victims may be in good flesh, and post-mortem examination usually shows nerve enlargement, or tumor formation, frequently of the ovary. In the more chronic form of the disease the birds generally show extreme emaciation with atrophy of the internal organs, and diffuse hemorrhages in the muscles giving the flesh a dark red, mottled appearance.



FIGURE 8.—Head of a chicken affected with gray eye. Note the irregular pupil which is a typical symptom of one type of avian leukosis complex.

Tumor formation (lymphoeytoma) is a common lesion in paralysis-infected flocks and may be found on the skin or in the internal organs. The liver is frequently the seat of either diffuse or nodular tumor formations which may cause enormous enlargement of this organ up to 200 grams or more. This is commonly called "big-liver disease," or leukemia. However, it is not a true leukemia as an abnormal number of leucocytes is not observed on examination of the blood. The ovary, kidneys, heart, lungs, spleen, digestive tract, or any other tissue may be the site of tumor formation. These tumors are firm and fleshy in consistence and white or gray in color. In the nodular type the tumor may vary from the size of a pinhead up to that of a hen's egg. In the diffuse type of tumor the organ involved is enlarged, firmer in consistence than normal, and usually shows a mottled gray discoloration instead of the normal pink or red.

Mode of transmission.—There is considerable evidence that this disease is spread by contact with infected birds and with contaminated surroundings. Field and laboratory investigations also furnish some evidence of transmission through the egg.

Control.—In attempting to control this disease two procedures are suggested, as follows: (1) Try to stamp out the disease by the use of

such measures as sanitation, culling, segregation, and in extreme cases disposal of the entire flock; or (2) attempt to reduce losses from the disease by breeding for resistance.

Under the first procedure the breeding flock is culled constantly to eliminate all sick birds showing lameness, droopy wings, twisted necks, gray eyes with irregular pupils, severe loss of flesh, pronounced paleness of the head, and tumors on the skin or muscles. Young chicks are reared as far removed from the old birds as possible. They should

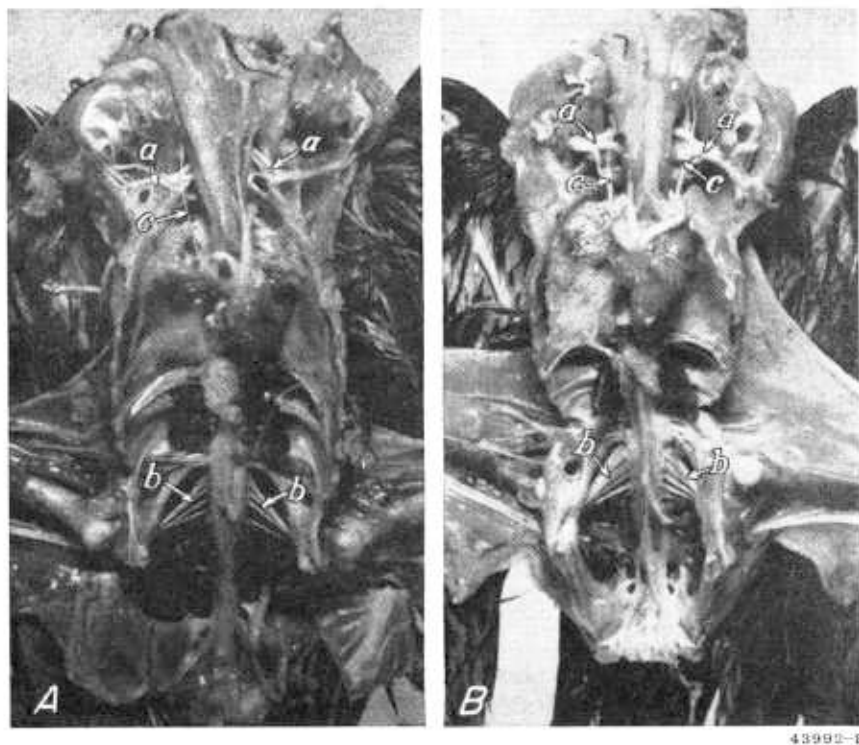


FIGURE 9.—A, Carcass of a fowl showing normal nerves (left vagus nerve not shown); B, carcass of a fowl dead of paralysis; *aa*, brachial nerves to wings; *bb*, lumbosacral nerves to legs; *cc*, vagus nerves to heart, lungs, and digestive tract. Note swollen nerves in carcass of fowl dead of paralysis.

be reared on clean ground and, if possible, cared for by one who doesn't attend mature birds. The pullets should be housed in clean, disinfected quarters separated from the mature birds.

If the flock is suffering severe losses, with low production, it may be more economical to dispose of all the birds, clean and disinfect the premises, and leave them vacant for as long as possible, particularly outdoor runs and ranges, before restocking. In restocking no assurance can be given that the new stock will not develop the disease, since the underlying cause and all the means of spread are not known.

In breeding for resistance the healthy survivors of an outbreak of the disease are retained as breeders. This is a slow procedure and requires years of careful selection of families which on the basis of progeny viability show the greatest resistance to infection. It has

been shown, however, that resistance may be increased by this method so that losses from leukosis are decreased to the point where it ceases to be of serious economic importance. In breeding for resistance no effort is made to avoid contact with the disease, since natural exposure is necessary to develop resistance.

Bronchitis

Bronchitis, also known as chick bronchitis, gasping disease, and infectious bronchitis, is a contagious respiratory disease which may affect chickens of all ages. It is caused by a filtrable virus.

Symptoms.—Affected birds cough and gasp as do birds affected with laryngotracheitis except that birds with the latter disease may cough up blood, whereas those having bronchitis do not. There may also be symptoms of coryza with discharges from the nose and eyes. In some outbreaks, however, respiratory symptoms may be absent or so slight as to be unnoticed.

The disease in laying birds causes a sharp and prolonged drop in egg production.

Losses.—Losses due to mortality are greatest in young chicks. These vary in different outbreaks but may be extremely high in very young chicks. In adults losses due to mortality are small, but egg production may drop as low as 5 to 10 percent and may continue below normal for as long as 6 weeks. There is also a serious loss in egg quality as regards albumen and shell. Shell texture improves with resumption of normal lay but albumen quality is reported to be permanently impaired in some cases.

Respiratory symptoms disappear usually within a week and recovery from an attack results in permanent immunity.

Diagnosis.—Infectious bronchitis must be differentiated from Newcastle disease, which it resembles. In the latter, mortality is usually higher and nervous manifestations may be seen. Also it may be mistaken for infectious coryza or laryngotracheitis. A differential diagnosis requires a laboratory test.

Control.—As in most virus diseases, medicinal treatment is of little or no value.

After an outbreak of the disease the entire flock should be destroyed and the house and equipment thoroughly cleaned and disinfected as explained on page 3.

Prevention.—No effective and feasible vaccine has been developed for very young chicks. However, in some parts of the country where the disease is prevalent and causes heavy losses, a system of immunization by natural exposure has been developed which is satisfactory. This immunization procedure is as follows: When the presence of infectious bronchitis is diagnosed by serum-neutralization test of the old birds, immunization of the young stock should be carried out in summer when the chicks are on range and between the age of 8 to 20 weeks. Several chicks from various parts of the range are inoculated with a dose of known infectious-bronchitis virus and turned loose on the range with the remainder of the flock. These inoculated chicks spread the disease so that they all get a light attack but this, however, confers a lasting immunity. At that time of the year when the chicks are in a vigorous growing condition an attack of the disease causes very little loss in gains and very little mortality.

It should be emphasized that when the chicks are exposed by this procedure they must be free of any other disease such as coccidiosis, pox, etc. Further, it is inadvisable to vaccinate against pox or laryngotracheitis within less than a month of the time that bronchitis immunization is done.

As with other virus disease such as pox and laryngotracheitis, the live virus should not be brought onto a farm unless the disease is already known to exist there, or it is certain that the birds will be exposed to the disease.

Epidemic Tremor (Encephalomyelitis)

Epidemic tremor (infectious avian encephalomyelitis) is an infectious and contagious disease of young chickens caused by a filtrable infective agent. Older birds may in some instances be affected with this disease.

Course.—In outbreaks of this disease, as many as 50 percent or more of the chicks may be affected, although not all affected chicks die. Some appear to recover, and others continue to manifest the tremor symptom to some extent. These fowls may mature to achieve a relatively normal egg production. Nevertheless, chicks which survive the disease in its acute form and regain normal condition should be finished off as broilers or fryers at an early age, as they may, if allowed to mature, become carriers of the infection. Not every hatch may be affected, since the disease may soon cease to occur or may recur sporadically during the hatching season with variable degrees of mortality. The disease is not known to occur in other species under natural conditions.

Symptoms.—In chicks up to about 2 weeks of age, the first symptom usually noted is sluggishness of movement with a progressive incoordination of the gait. With the increased inability to move, the chick develops a weakened cry. Tremor symptoms (shaking of the head and quivering of the wings) usually appear at about this stage of the disease, frequently accompanied by complete helplessness of the chick, which may perish for lack of food or drink or may be trampled to death by the other birds. The rate of violent deaths is enhanced by reason of the irresistible drowsiness which attacks many of the affected chicks.

Transmission and control.—Epidemic tremor is not readily transmissible in the brood by direct contact. It has been suspected that the infection may be transmitted by the hen to its chick through the egg. Chicks taken from infected incubators and sold to remotely located purchasers may subsequently develop the disease. Chicks or hatching eggs should, therefore, be obtained from sources known to be free of the disease. Susceptible stock should not be allowed contact with affected or apparently recovered chicks or hens. It has been reported that some strains of chickens are more susceptible than others. If the disease is promptly diagnosed in a brood, the affected individuals should be removed to isolated quarters or destroyed. Sanitary measures in the incubation of eggs and the brooding of chicks should be carried out, as discussed under the headings "Disease Prevention," "Disease Control and Eradication," and "Pullorum Disease" of this bulletin. There is no medicinal treatment known for the prevention or cure of epidemic tremor.

Fowl Pox

Fowl pox, avian diphtheria,¹⁰ and canker are but external and internal manifestations, respectively, of the same disease. The virus which causes the formation of warts or pox nodules on the head, typical of fowl pox, also causes the cheesy patches in the mouth and eyes which are characteristic of diphtheria. Chickens and pigeons are most frequently affected, but turkeys and birds generally are susceptible.

Cause.—Fowl pox is caused by a virus which is capable of passing through laboratory filters. The disease is strictly infectious and never develops as a result of exposure to dampness and drafts alone, although these conditions favor its spread and tend to increase its malignancy.

Transmission.—The contagion is introduced and disseminated in a flock by contact with infected (carrier) birds. Its spread depends upon the presence of abrasions of the skin or mucosa of the mouth parts. Pox virus may be disseminated also by mosquitoes.

Canker of pigeons may be disseminated from infected parents to their offspring during the act of bill feeding. The eggs or squabs of such breeders should be given to healthy foster parents.

Symptoms.—The disease has the general symptoms of roup but is distinguished from it by an eruption of pox nodules on the head and by the presence, in the mouth, throat, and eyes, of tough, cheesy patches which are firmly attached to the tissues beneath them (fig. 10).

The eruption appears as round, oblong, or irregular shaped nodules from the size of a pinhead to that of a



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FIGURE 10.—Fowl pox nodules on comb, on wattles, and near corner of mouth. (After Hutýra and Marek.)

pea or a hazelnut. It is seen especially about the beak and nostrils and on the comb, the eyelids, the wattles, and the ear lobes. In some birds, particularly in pigeons and turkeys, the eruption is more generalized and is found on the skin of other parts of the body, as the neck, under the wings, on the rump, on the breast of turkeys, and about the vent. Here the nodules may become larger than on the head. The nodules begin as small, red, or reddish-gray growths with a shiny surface and gradually enlarge, while the color changes to a yellowish, brownish, or dark brown, and the surface dries and becomes shriveled, uneven, and warty in appearance. Owing to the number of nodules and the extension of the inflammation, large patches of skin become thickened and covered with hard, dry crusts, closing the nasal openings or the eyelids, and making it difficult to open even the beak.

¹⁰ This disease has no relation to human diphtheria.

The severity of the disease depends much on the extent of the internal diphtheritic deposits (fig. 11). These are at first thin and yellowish or whitish in color, and gradually become thicker, firmer, and more adherent, so that considerable force is required to remove them. The mucous membrane beneath the deposit, when the latter is removed, is found to be inflamed, ulcerated, and bleeding, but it is soon covered by a new deposit. This exudate is called a false membrane, and when it is situated where the breathed air passes over it, it dries and becomes uneven and fissured, and its color changes to a dark brown. In pigeons the exudate is more friable and easily removed, and the mucous membrane beneath it is reddened but not ulcerated.



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FIGURE 11.—Diphtheria. Neck slit open to show diphtheritic patches in mouth and esophagus. (After Rätz.)

While the false membranes over the parts first affected are becoming thicker, the inflammation extends to the adjoining surfaces, and new diphtheritic centers develop, uniting with one another until the cheeks, tongue, palate, throat, and inside of the nostrils are covered. Very often the inflammation extends from the nostrils to the eyes, and sometimes it penetrates the air tubes to the lungs, or the gullet to the crop. When false membranes form in the gullet, crop, and intestines there is a rapid aggravation of the symptoms, such as intense diarrhea, and the escape of blood with the droppings. This type of the disease is more frequent in waterfowl than in other birds. Some fowls in a flock are resistant, and after a few days of illness rapidly recover. Others remain dull, weak, and thin in flesh, and may have more or less

catarrh and difficulty of breathing for a long time.

The period between exposure to the contagion and the appearance of the first symptoms varies from 3 to 15 days. The duration of the disease varies from 2 or 3 days to as many weeks in the acute cases, while the chronic form may continue for several months.

Treatment.—The treatment of fowls severely affected with diphtheria requires much time and patience, and as a rule does not pay. It is often better to kill the birds, bury or burn their carcasses, and disinfect the poultry houses, and in that way eradicate the contagion as soon as possible.

Prevention.—In order to diminish the possible interference with the productivity of the flock, the birds should be vaccinated at 3 to 5 months of age. Vaccination of a flock of poultry is not recommended, however, under any circumstances, unless the disease has been known to exist on the premises, or the owner considers that his flock is in danger from infection in neighboring flocks. Neither

should chickens be subjected to the ordeal of vaccination when in a debilitated, sickly condition, or when heavily infested with parasites. Show birds or those in egg-laying contests should be immunized against pox at least 6 weeks before being sent to exhibitions or contests.

There are two methods of vaccination, the stab, or stick, method and the follicle method. The stab method is a more recent development and seems to have several advantages over the older follicle method; vaccination can be accomplished much more easily and quickly, much less vaccine is required, and it is more sanitary.

In the stab method a narrow, sharp-pointed knife or lancet with adhesive tape wrapped around the blade about one-eighth inch from the point is used. Vaccination is accomplished by dipping this instrument into a bottle of vaccine and making a quick stab sufficient to penetrate the skin. The most convenient site to vaccinate by this method is on the outside of the leg near the knee (patellar) joint where the rows of feathers are far apart and the stab can easily be made between the rows.

A variation of the stab method recently reported is the use of two sewing-machine needles pushed through a cork with the points about one-fourth inch apart. When this instrument is used the wing is stretched out and the web is pierced from the under side, thus making four vaccination points through the double layer of skin simultaneously. The eyes of the needles take up sufficient vaccine to make it effective.

When vaccinating is done by the follicle method the procedure is as follows: Pluck out several feathers from the front part of one leg, and with a cropped, bristle brush, or other suitable applicator, rub the vaccine into the empty feather follicles.

The reaction denoting a so-called vaccination take may be noticed in 5 to 7 days. The site of vaccination will show inflammation and later the formation of a scab, which will drop off in about 30 days.

Pigeon pox vaccine confers a temporary immunity lasting only a few months. It should be used instead of fowl pox vaccine where there is danger of an outbreak of fowl pox in a laying flock, as it causes little, if any, disturbance to health or egg production. It can also be used where it is desired to vaccinate only a small group of birds, as there is no danger of causing an outbreak among unvaccinated birds on the premises as is the case when fowl pox vaccine is used.

Pigeon virus vaccine is always administered by the follicle method. Pluck from 12 to 15 feathers and brush the vaccine vigorously into the follicles. This virus and technique must be used in immunizing pigeons also.

Laryngotracheitis (Influenza)

Infectious laryngotracheitis (influenza or "flu") is observed among chickens during the fall and winter months, especially in the large, central, poultry-feeding establishments of the Middle West, and during the shipment of the fowls by rail to the principal poultry markets.

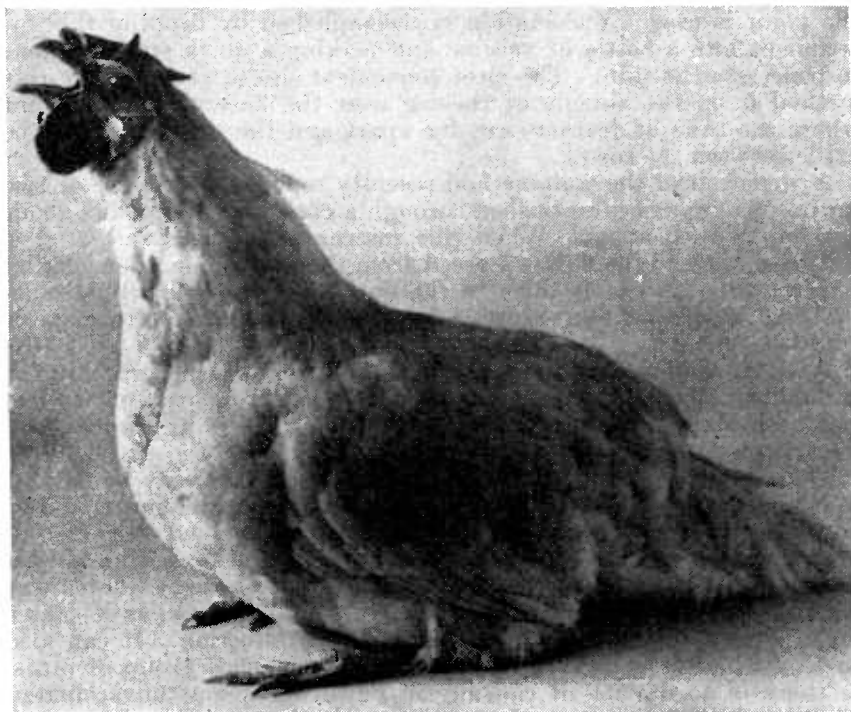
Cause.—The disease is caused by a filtrable virus.

Symptoms.—Difficulty in breathing causes the bird to extend the head and open the beak for each respiration (fig. 12), and there is usually a rattling noise caused by obstruction of the windpipe. The bird becomes ruffled and unkempt. The facial expression is dis-

tressed. Appetite rapidly diminishes. Sticky exudates in many cases are present in the mouth and nasal cavity.

Affected birds may recover, although many die within 3 or 4 days after exposure, or may succumb after a week or 10 days. Death is usually caused by asphyxiation from the mechanical obstruction of the windpipe with dry, cheesy exudates. These are, as a rule, more darkened and fibrinous than those of diphtheria, and are found only in the air passages.

Post mortem appearance.—Autopsy reveals no significant lesions except an inflammation of the nasal tract and windpipe, which are



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FIGURE 12.—Hen affected with infectious laryngotracheitis, showing typical appearance due to difficult breathing. (Photo by J. R. Beach.)

obstructed with a mucopurulent or fibrinous exudate, frequently tinged with blood.

Treatment.—No satisfactory flock treatment is known.

Control.—The control of this disease is favored by the application of such measures as cleaning and disinfecting the premises, destroying all sick birds, burying or burning all carcasses, and providing comfortable, spacious, and well-ventilated quarters for the flock.

The eradication of the disease necessitates the rigorous application of sanitary and hygienic precautions. The essential points of a plan of eradication of infectious laryngotracheitis which is in use in Massachusetts are given in the following paragraph. This plan is especially adaptable to isolated outbreaks of the disease, or outbreaks occurring

in areas where the poultry population is small or segregated in remote units.

Gather the required number of eggs for hatching and then dispose of the entire breeding flock which has been exposed to or affected with the disease. Cleanse and disinfect incubators and brooders, and remove them to a safe distance from the disease-infected premises. Use every sanitary precaution in hatching the eggs and brooding the chicks. Cleanse and disinfect buildings and equipment used by the diseased flock as soon as possible after their removal. Then open the doors and windows, allowing the air and sunshine to enter and let the houses remain vacant for 2 months or longer. No clothing or footwear worn around the diseased flock or their premises should be worn when working with the chicks for restocking, unless such apparel has been thoroughly cleansed or disinfected. Introduce new stock only from flocks known to be free of the disease, or raise chicks from your own safeguarded hatches. Safeguard the flock from the introduction of the disease by chickens from diseased flocks, visitors from contaminated localities, hucksters, stray dogs, and similar sources.

A vaccine for the prevention of infectious laryngotracheitis is propagated on chick embryos. This product is prepared by rapidly drying and pulverizing the tissues of affected embryos. The powder is mixed with a measured proportion of sterile fluid and is applied to the bursa of Fabricius (an invaginated sac adjacent to the cloaca) with a small bristle brush or swab. A temporary local reaction, about the fifth day, consisting of an inflammation of the vaccinated area, shown by redness and swelling, is regarded as an indication that the vaccination was successful.

This vaccine should not be used in flocks except where the disease has already existed or is dangerously prevalent in the vicinity, since the introduction of the living virus in this way may produce the active disease, and necessitate future vaccinations on the premises. Debilitated birds or birds less than 6 weeks of age should not be vaccinated against this disease.

Newcastle Disease

Newcastle disease, also known as avian pneumoencephalitis, is a highly contagious virus disease involving primarily the respiratory and nervous systems of domestic fowl. It is characterized by a sudden onset and extremely rapid spread through a flock. The disease was first recognized as a new disease entity in Dutch East Indies in 1926. Shortly after this, the malady appeared at Newcastle-on-the-Tyne in England. The current name of the disease is derived from this occurrence. Although the disease is now considered to have been present in California for at least the past 10 years, it was not until 1944 that the infection, first called avian pneumoencephalitis, was recognized as Newcastle disease.

The virus attacks chickens of all ages, from baby chicks to laying hens. Turkeys are very susceptible, and pigeons, geese, ducks, and other barnyard fowl may be attacked. The time between exposure and appearance of symptoms may vary from 2 to 14 days. The average time is generally considered to be about 5 days.

Transmission.—The disease may be spread by direct or indirect

contact. It may be carried from one farmyard to the next by visitors, such as poultry buyers, feed deliverers, and remedy salesmen. The practice of feed dealers of collecting used feed bags and reusing them may explain some outbreaks of the disease. It is known that the virus may survive on an infected premises for 2 or 3 weeks following an outbreak of the disease and it is recommended that poultry houses be vacated for at least 30 days before being restocked with susceptible birds. Circumstantial evidence has at times pointed to hatcheries as disseminating agencies and there is some evidence to indicate that transmission through eggs does occur.

Symptoms.—In chicks and broilers, Newcastle disease begins with respiratory symptoms resembling those of infectious bronchitis and laryngotracheitis. The first symptom observed is difficult breathing accompanied by gasping. Some of the chicks will emit a peculiar shrill cry that may be heard above the other sounds in a poultry house. The birds are visibly depressed and weak. A few days after the respiratory symptoms appear, nervous disturbances are encountered. The birds may lie on their sides, with paralysis of one or both of the legs or wings. The equilibrium is altered so that birds may do somersaults, turn over backwards, walk backwards, or twist the head and neck into all sorts of contortions. Tremor of the head is common.

In adult chickens the respiratory symptoms are generally less pronounced than in chicks and may pass entirely unobserved. A common feature of the disease in adult birds is sudden cessation of egg production, which requires a month or longer to return to normal.

The mortality is influenced by the age of the bird and complicating conditions such as coccidiosis, infectious coryza, deficiency diseases, heavy parasitisms, or other diseases. Instances in which losses in young birds were as high as 90 percent have been reported. Ordinarily the mortality in broiler houses varies from 10 to 30 percent. In adult birds the mortality is about 5 percent. In broiler houses, many of the survivors remain unthrifty for several weeks following the outbreak.

Diagnosis.—Unfortunately symptoms alone are a very unreliable basis for judgment as to whether a flock of sick birds have Newcastle disease. The disease resembles other infectious maladies, such as infectious bronchitis, laryngotracheitis, and epidemic tremor. A respiratory disease followed by or associated with nervous or paralytic symptoms would tentatively point to Newcastle disease. A laboratory diagnosis of the disease is more accurate and, therefore, more desirable than a clinical diagnosis. Post mortem examination does not offer much for diagnosis. The most characteristic finding is that the normally transparent air-sac membranes are cloudy and may contain a variable quantity of a lemon-yellow material.

Control.—Medicinal treatment is of no value in this disease. Every effort should be made to avoid introduction of the disease into a flock by following approved methods of poultry management. One must bear in mind that recovered birds may become carriers of the disease. Birds exhibited at poultry shows or egg-laying contests should never be returned to the owner's poultry farm. Indiscriminate admission of visitors from potentially infected premises should be avoided. Dead birds should be properly disposed of. Flock owners should insist that feed dealers deliver feed in new unused bags and that poultry and egg buyers furnish clean disinfected crates and cases.

Following an outbreak of Newcastle disease it is advisable to market for slaughter all survivors. In case it is necessary to keep laying hens that have survived an outbreak, no hatching eggs should be sold for at least 60 days following the outbreak.

Experimental work carried out in the laboratory and in the field with various vaccines indicate that considerable promise lies in this method of control. A killed-virus vaccine is available for general use which produces an immunity of short duration and may be used satisfactorily in broiler production. Also, experimental attenuated live-virus vaccines have been introduced which produce lifelong immunity. Repeated testing of these agents under various field conditions will determine their practicability.

Live-virus vaccines should not be used on a premise unless Newcastle disease is known to be present, or in the immediate vicinity so that exposure to the disease is almost certain to occur.

Chicks hatched from eggs laid by Newcastle-disease-immune hens receive antibodies via the yolk which render them immune to the disease for a period of 2 to 4 weeks after hatching. Because of this, many hatcherymen prefer to hatch eggs from flocks which are known to be immune to the disease.

Psittacosis (Parrot Fever) and Ornithosis

Psittacosis is an infection caused by a virus-like agent affecting primarily the birds of the parrot family. Particularly in pet shops, the disease may be transmitted to canaries, finches, doves, and other birds. The clinical symptoms exhibited by birds ill with the infection cannot be considered characteristic and diagnosis is entirely dependent upon autopsy and laboratory findings.

Psittacosis is also transmissible to man where it is manifested as an influenza-type pneumonia with a mortality of around 20 percent.

An inapparent, or latent, infection in pigeons has been discovered which is immunologically indistinguishable from psittacosis. The term "ornithosis" has been applied to this disease. The virus has also been isolated from the chicken and the fulmar. It is believed that this disease is widespread in pigeon lofts of this country. As it is so difficult to separate this disease from psittacosis, it has not been established just how susceptible man is to the infection.

DISEASES CAUSED BY FUNGI (MOLDS)

Aspergillosis

Aspergillosis is a fungus disease of the lungs and air sacs which may affect any of the domestic birds and is quite prevalent in birds confined in zoos or other aviaries. It is regarded as one of the causes of brooder pneumonia in baby chicks.

Cause.—The causative agents are the common green mold (*Aspergillus fumigatus*) and the black mold (*A. niger*) which grow on vegetables and other kinds of matter. Warmth and moisture favor their development. When moldy hay, straw, or chaff is given to the fowls to scratch in, or moldy grain is fed, the spores of the fungi are inhaled by the birds.

Symptoms.—The disease may be limited to a single bird, or it may

assume the form of an extensive outbreak among adult fowls. Occasionally it may cause a brooder pneumonia among chicks, but this should not be confused with brooder pneumonia due to pullorum disease. When the air tubes or lungs are attacked, the first symptom is a slight catarrh, with accelerated breathing. Soon the swellings obstruct the passage of air, and there is a rattling or croupy sound heard chiefly during expiration. The affected birds mope, separate themselves from the remainder of the flock, or remain in a sitting posture; if made to move, they appear weak and scarcely able to walk, and if they try to run they soon fall from exhaustion. The difficulty of breathing increases rapidly; they gasp for breath and make movements of the head and neck as if choking; there are fever, diarrhea, drooping wings, great depression, a tendency to sleep, and finally suffocation and death.

When the disease is limited to the large air sacs the only symptoms are weakness and progressive loss of flesh. If the small air sacs of the bones are involved there may be lameness, with swollen and inflamed joints. The symptoms in brooder chicks are similar to those of pullorum disease. Aspergillosis is always fatal. Young chicks die within a few days. Older birds may live from 1 to 4 or more weeks after the appearance of symptoms.

Post mortem appearance.—The walls of the windpipe, air passages in the lungs, and air sacs in the body cavity show whitish or yellowish nodules in the early stages of the disease. Later the walls are covered by elevated, dirty-yellow, or greenish layers, which represent growths of the mold, and the air sacs may become completely filled with firm yellow pus.

Prevention.—The disease is prevented by giving only clean and bright straw or chaff for the fowls and brooder chicks to scratch in, by keeping the houses and yards clean, and seeing that all grain and meal fed are sound and entirely free from mold. The sick birds should be removed from the flock, and the bodies of those which die should be burned or buried.

Favus (White Comb)

Favus of fowls is a contagious disease that begins with the formation of grayish-white spots on the comb, ear lobes, or wattles.

Cause.—This disease is caused by a fungus called *Achorion gallinarum* and is transmitted from fowl to fowl by simple contact.

Symptoms.—Favus generally begins on the bare parts of the head as small, white, or grayish spots, which increase in number and size until the whole surface is covered with dry, scaly, dirty-white crusts with an irregular surface. As the disease advances the neck and body are gradually invaded, and the feathers become brittle and break off, leaving a deep depression in the center of a cup-shaped disk. The disease when limited to the comb and wattles may disappear without treatment, but after it has invaded the feathered parts it almost invariably continues to advance, and the birds grow weaker until they die.

Treatment.—When only the bare parts of the head are affected, the disease may be cured by daily applications of tincture of iodine to the diseased areas. It is essential to separate the affected bird

from the flock. If the feathered parts of the body are affected, it is advisable to kill the bird.

Thrush

Thrush is an infectious disease of the mouth and crop, and sometimes of the esophagus and glandular stomach, of young chickens, pigeons, turkeys, and geese. The disease is caused by the fungus *Oidium albicans* and is manifested by the formation of grayish-white or yellowish patches on the mucous membranes of the parts named. These patches may eventually enlarge and coalesce. A slimy discharge may drool from the mouth of the affected bird. Loss of appetite and consequent weakness and emaciation attend the disease.

Treatment.—The sick birds should be isolated. The visible thrush deposits in the mouth and throat cavities should be removed with forceps, and the erosions painted with glycerin-iodine solution (tincture of iodine, one part; glycerin, four parts). If the crop is affected it may be flushed out with a 2-percent boric acid solution. The quarters and equipment should be cleaned and disinfected.

DISEASES OF THE DIGESTIVE ORGANS

Impacted Crop (Crop-Bound)

The affection known as impacted crop or crop-bound is an over-distended and paralyzed condition of the crop, generally caused by overeating or by swallowing coarse and indigestible substances, such as feathers, or fibrous feeds, especially straw. In fowl cholera and some other diseases, the crop is paralyzed as a result of the disease.

Symptoms.—The first symptom is a loss of appetite, or an effort of the bird to swallow without being able to do so. The crop is very large and much distended, with contents more or less firmly packed together. If permitted to continue, the condition becomes aggravated, breathing is difficult, and death may result.

Treatment.—The contents of the crop may be removed sometimes by forcing the bird to swallow a teaspoon or more of sweet oil and massaging the lower part of the gullet, if it contains feed, or if not, the part of the crop nearest to the gullet, until the contents are softened and may be pressed toward the head. This is made easier by holding the bird head downward. By continued manipulation the greater part of the material may be removed. The bird should not be permitted to eat for several hours after it is relieved. If this treatment is not successful, the crop may be opened with a sharp knife and the contents removed through the opening, a coffee spoon, a button hook, small forceps, a bent wire, or other suitable instrument being used for this purpose. Then wash out the crop with clean, warm water. The opening should not be more than an inch in length and should be closed with three or four stitches, first in the wall of the crop and, when this is finished, by an equal number in the skin. Each stitch should be made and tied separately. Coarse, white silk is the best material, but if it is not available ordinary cotton thread may be used. Feed the bird for a day or two on milk and raw egg, beaten together, and gradually change to soft mash.

Inflammation of the Glandular Stomach (Proventriculitis)

Inflammation of the glandular stomach (proventriculitis) is often seen in growing chicks reared in confinement, and occasionally in adult fowls.

It is generally due to dietary deficiency or some debilitating disease. It is characterized by a thickening of the wall so that the glandular stomach takes on a globular shape. The lining mucous membrane usually shows various stages of inflammation, ulceration, and atrophy of the digestive enzyme-secreting glands. This glandular atrophy results in poor digestion and emaciation.

This condition can be definitely diagnosed only on autopsy, but if chicks show emaciation in the absence of any other apparent cause, proventriculitis should be considered.

Inflammation of the Intestines (Enteritis)

Enteritis is an inflammation of the lining (mucous) membrane of the intestines. It is not a distinct disease but results from some other condition, such as malnutrition, infectious diseases, or the presence of internal parasites.

This inflammation may vary in degree from a mild catarrh in which there is an excess of mucus and pus in the intestine to a severe hemorrhagic type in which there is capillary hemorrhage into the lumen and the intestinal contents are bloodstained. In severe chronic cases ulcers or erosions of the mucous membrane may develop so that digestion and assimilation of food are seriously interfered with and poisons are absorbed into the circulation. In other cases irritating substances in the diet may cause diarrhea.

Treatment.—This consists in diagnosing and treating the condition that caused the inflammation. If malnutrition is the cause, the diet should be balanced with proper feed, which should contain adequate amounts of the vitamins. All injurious and irritating substances such as sand, straw, or shavings should be removed when there is a tendency to depraved appetite. If parasites are the cause of the inflammation, measures should be taken to eliminate them. In most cases of enteritis medication is not advisable.

Indigestion

Indigestion may be attributed to numerous conditions such as loss of appetite, pica (abnormal or depraved appetite), sour or hanging crop, impaction of the gizzard, diarrhea, and constipation.

Cause.—The principal causes are irregularities of feeding; feed that is too coarse, dry, or fibrous; moldy or decayed feed; access to poisonous plants or irritating chemicals; or polluted water supply.

Indigestion may also occur as a symptom of some diseases, such as catarrh of the crop or stomach, enteritis, and parasitism, in which cases special treatments should be given.

Treatment.—The ration should be clean, wholesome, and well-balanced and should be supplemented by a constant supply of insoluble grit. For impaction of the gizzard or constipation, Epsom salts, 1 pound to each 10 quarts of drinking water, may be placed before the flock for 1 day instead of other drinking water; or castor oil, 1

pint per hundred birds, may be fed thoroughly mixed in a moist mash.

Sour or hanging crop may be treated by flushing out the crop with a bicarbonate of soda solution consisting of two teaspoons of the soda to a pint of warm water, in a fountain syringe. Hold the head of the bird down, and empty the crop by gentle pressure, repeating the process daily until the bird recovers. Keep the bird on a soft diet, principally sour milk or buttermilk, for several days after recovery takes place.

DISEASES OF THE REPRODUCTIVE ORGANS

Egg-Bound

The condition known as egg-bound (failure to pass the egg in the normal manner) is of frequent occurrence in fowls, especially in pullets beginning to lay.

Cause.—The difficulty may be due to inflammation, stricture, or tumor formation in the posterior part of the egg passage. Sometimes malformed or double-yolked eggs are responsible. In pullets the usual cause is the attempted passage of a large-sized egg before the egg passage has become sufficiently dilated to accommodate it.

Symptoms.—Affected hens become restless and make frequent visits to the nest in their effort to lay. The straining may cause inflammation and often eversion of the oviduct (egg tube) through the vent. Others of the flock, attracted by the inflamed, protruding parts, peck at them and tear out portions of the egg passage and intestine, causing the death of the hen. If prolapse does not occur, the distressed fowl may continue her efforts to lay until successful or until overcome by weakness or internal hemorrhage from rupture of the oviduct. The egg may be felt by passing the forefinger through the vent.

Treatment.—The surest method of treatment is to remove the egg by the following procedure: Pass the forefinger through the vent. With the other hand pressing on the abdomen of the fowl force the egg toward the vent, guiding it by the aid of the inserted finger. When the shell is observed through the vent, puncture it with an awl or other sharp-pointed instrument, break it in pieces, and withdraw these and the egg contents. Isolate the bird and inject cold water into the cloaca (the common passage into which the intestine and the oviduct open) to reduce the inflammation. If the oviduct has been everted through the vent, clean and push the parts back and inject cold water frequently until the tissues remain in place.

Inflammation of the Egg Duct (Salpingitis)

Inflammation of the egg duct is characterized by a whitish diarrhea and a creamy discharge from the egg duct which soil the feathers around the vent and cause redness and irritation of the skin. Other birds attack the affected individual, severely lacerating the posterior parts and in a short time disemboweling the victim.

The sporadic occurrence of bloody eggs, stinking eggs, misshapen eggs, yolkless eggs, eggs with blood-smeared shells, soft-shelled eggs, egg-bound, etc., may at times be traceable to isolated cases of salpingitis and may even be the forerunner of a general outbreak of the disease. Some outbreaks of salpingitis are traceable to infection with

Salmonella pullorum. Many cases of peritonitis caused by the internal rupture of infected egg yolks may be variations of this disease.

Treatment.—When only a few birds are affected, relief may be afforded by douching the egg duct with a one-half of 1-percent solution of creolin. Segregating the visibly affected birds, thus protecting them from attack by others, should increase the number of recoveries. Male birds should be kept away, as they may spread the infection to healthy hens through breeding activity. This condition often occurs, however, even in virgin pullets, without reference to the activities of the male.

In outbreaks of salpingitis which may be traced to *Salmonella pullorum* infection it would be unwise to use for breeding purposes any birds which had been affected, as to do so may cause the spread of pullorum disease in the chicks.

Vent Gleet (Cloacitis)

Vent gleet is an ulcerative condition of the cloaca of fowls, the cause of which is not known.

Symptoms.—There is inflammation of the cloaca and vent. The skin around the vent is swollen, reddened, and ulcerated, and an offensive odor is usually present. The droppings are foul smelling and liquid, and are frequently voided. Other chicks may peck at the inflamed part and often tear the cloaca and rectum, causing the death of the victim.

Treatment.—The disease is very resistant to treatment. It is usually better to destroy the bird. If treatment is desired, 3-percent silver nitrate solution may be applied to the mucous membranes of the cloaca by means of a cotton swab, or 2-percent carbolic ointment may be applied daily over the affected area. Repeated application of a 3-percent solution of chromic acid, by gently bathing the affected area once every 3 or 4 days has been reported as beneficial in this disease.

ENVIRONMENTAL DISEASES

BREAST BLISTERS

The occurrence of blisters on the skin of the breast of chickens is of considerable economic importance to the industry, for the reason that breast blisters constitute a serious blemish from the standpoint of marketability of poultry for food purposes.

The problem occurs principally in battery-reared birds and is probably due to a combination of circumstances. Birds that are fattened at an early age have a tendency to rest their weight by sitting a good deal of the time in a recumbent position on the battery floor. Sometimes the feeders are placed so low outside the batteries that the larger birds find it necessary to crouch in order to eat. The irritation of the wire floors or rough or dirty roosts on the tender skin of young or fast-growing birds is likely to produce breast blisters.

Prevention.—Breast blisters may be prevented to some extent by such changes in the system of management as will tend to keep the birds from resting on their breasts. Even on wire floors abundant clean litter may be provided that will protect their skin from the rough

metal. The mash troughs may be elevated and the portholes adjusted so that the birds may eat in a standing position. Rough or dirty roosts should be replaced.

CARBON MONOXIDE POISONING

Young birds must have abundant fresh air to maintain health and promote growth and development. Brooder houses heated by open fires, gas, wood, coal, or oil burners may develop dangerous gases unless sufficient oxygen is present in the air to support normal combustion. Provision must be made for the proper intake of fresh air and a corresponding outlet for foul air.

In poorly ventilated brooders deadly carbon monoxide gas sometimes accumulates. Very small quantities of this gas will kill a chick or poul in a short time, especially during a cold night or stormy weather when the minimum of fresh air is usually provided. Overcrowding and too high temperatures increase the chances of gassing in badly ventilated brooders.

The chief symptoms of acute gas poisoning are stupor, drowsiness, labored breathing, a wobbling gait, and spasms. In subacute cases the appetite is poor, the feathers rough, the birds are stunted, and additional evidence of lowered vitality may be seen. Measures to prevent losses from noxious gas include the use of electric heaters, or hot-water heating devices with the boiler entirely outside the brooder house. When other types of heating are used, special care should be given to proper ventilation for both the normal operation of the stoves and for the comfort of the young birds that are being brooded.

"MUSHY-CHICK" DISEASE (OMPHALITIS)

This condition, sometimes called navel infection, is characterized by the death of the affected newly hatched chicks in the incubator. The tiny carcasses are found in a soft condition flattened against the floor of the hatching trays. An extremely offensive odor is present.

Mushy-chick disease is thought by some investigators to be due to a possible combination of insanitary hatching conditions and possibly an excess of humidity in the incubator at hatching time which prevents the closing of the navel after the yolk sac has been drawn into the body cavity of the chick. Bacteria of various kinds gain entrance into the umbilical opening and set up the infection resulting in the death and softening of the chicks.

The prevention of this condition lies in the proper cleanliness and sanitation about the hatchery. Procedures recommended under hatchery sanitation in the control of pullorum disease are equally applicable in combating mushy-chick disease.

MISCELLANEOUS DISEASES AND CONDITIONS

ARTHRITIS (INFLAMMATION OF THE JOINTS)

This is an inflammatory condition surrounding the joints of the legs or wings of chickens, turkeys, pheasants, pigeons, young ducks and geese, and other species, causing lameness of the affected member.

Cause.—The disease is caused by a micro-organism known as *Staph-*

yllococcus aureus, which multiplies in the region of the joints. In young ducks or geese the disease may assume an acute character, causing death in from 2 days to 2 weeks. Survivors may gradually recover. In acute cases there are general depression, diarrhea, and discharge from the eyes. In chronic cases the general symptoms are less marked, but emaciation is pronounced. In either type characteristic symptoms are lameness and swelling of the affected joints. The swellings are hot and painful. The bird lies on its breast with legs extending backward and, if forced, can move only a short distance by flapping its wings. Sometimes the wing joints are swollen and the wings droop. In young ducks and geese especially the intestine may be inflamed, with slimy reddish contents, and the liver and spleen may be enlarged. The affected joints are red, swollen, and surrounded with yellowish fibrinous or cheesy exudates.

Treatment.—Acute cases do not respond favorably to treatment. The joints should be painted daily with tincture of iodine. Isolate the affected birds, and keep the houses and utensils clean and disinfected. The birds should not have access to stagnant water. Clean feed and water should be provided.

This disease should not be confused with the lameness caused by gout, perosis, fowl cholera, paratyphoid (in pigeons), fowl tuberculosis, paralysis, or bumblefoot, which are discussed elsewhere in this bulletin.

BUMBLEFOOT

Bumblefoot is a term applied to a swelling of the foot in fowls.

It may result from bruises or from cuts or punctures of the skin of the foot, which becomes infected by germs. The invading organisms set up an inflammation with the formation of fluid or cheesy, suppurative material, in the ball of the foot, in the spaces between the toes, or in both locations (fig. 13). It is observed frequently in chickens that have limited quarters and spend a large amount of their time on the roosts. Roosts which are not adaptable to the shape of the feet of chickens or which are dirty may be predisposing causes.

Treatment.—In some cases the application of tincture of iodine to the swollen area daily for several days will bring about recovery. If the swelling is hot and has the appearance of an abscess, it should be lanced and the contents washed out. The interior of the abscess is then soaked with 5-percent carbolic acid or tincture of iodine and the



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FIGURE 13.—A typical case of bumblefoot in a chicken.

foot bandaged. The fowl should be placed in a small compartment without a perch and the wound disinfected daily for several days.

LIMBER NECK (BOTULISM)

The condition known as limber neck is a symptom of several diseases, among which are botulism or other food poisoning. It is characterized by a paralysis of the muscles of the neck, which makes it impossible for the bird to raise its head from the ground. This condition is due to the absorption from the crop or intestines of poisons which act on the nervous system and cause paralysis. It is generally associated with the eating of spoiled feed or putrid meat in which certain poison-producing organisms are growing, or of fly maggots which have bred on such material.

Treatment.—The best treatment is to give a full dose of purgative medicine—that is, one-half teaspoonful of Epsom salts, or three or four teaspoonfuls of castor oil for a grown fowl. Unless treatment can be given very promptly there is little hope of saving the bird. Spoiled canned goods should not be fed to chickens. Carcasses of fowls or other animals should be burned or deeply buried as soon as found.

PULLET DISEASE

This is a disease of unknown cause which has a variety of designations. It has been called avian monocytosis, blue comb, X disease, choleralike disease, contagious indigestion, Bright's disease, and acute toxemia.

It is said to be due to metabolic disorders and to resemble the toxemias of other animals. In the chronic form it is indistinguishable from visceral gout.

It usually occurs in pullets just coming into production either on range or after being housed. However, males may also be affected, as well as chicks as young as 4 weeks and hens up to 2 years. Vigorous, well-nourished pullets are most frequently attacked. The disease occurs more often in hot weather. It has been reported from various parts of the country including the Northeast, the Middle West, and the Pacific coast.

Symptoms.—The acute form may suddenly attack a large proportion of a flock, causing depression, loss of appetite, diarrhea, and a severe drop in egg production. There may be shrivelling of the skin, darkening of the comb (blue comb), and fever in the later stages of an acute attack. Mortality varies from 0 to 50 percent, with an average of 5 percent.

The course is about 2 weeks but egg production may remain below normal for several weeks.

Post mortem appearance.—The post mortem changes are variable, depending on the stage of the disease. The liver often shows yellowish pin-point spots. Most organs are congested. The victim is usually in good flesh. The intestines show an abundant catarrhal (mucoid) exudate. The kidneys are usually swollen and may reveal chalk-like deposits, as in gout. The spleen is usually normal. The ovary may show flaccid or broken follicles.

This disease may be confused with cholera, fowl typhoid, or occa-

sionally with the acute form of pullorum disease. In order to differentiate from these diseases it is necessary to resort to bacteriological culture of the various organs. In pullet disease no pathogenic organisms will be recovered on culture.

Control.—No specific treatment is known for this disease though various measures for its control have been used which were thought to be beneficial. Among them are the administration of molasses in the feed or drinking water. A wet mash containing 40 parts of molasses and 60 of mash may be fed in the morning every other day for several days. Symptomatic treatment recommended is to cut down on the mash, give plenty of fresh water, and provide the birds with clean quarters.

ROSE CHAFER POISONING

Rose chafers, or rose beetles (*Macrodactylus subspinosus*) are extremely poisonous to chickens under 10 weeks old. They are found in the Atlantic Coast, Middle West, and Central States. When these beetles are on vegetation, chickens devour them readily. Fifteen to twenty rose chafers are sufficient to kill a chicken 1 week old, while birds about 3 weeks of age show a toxic reaction after eating 25 to 45 of these insects. Mature fowls are seldom killed.

Symptoms.—Signs of poisoning may appear as early as 1 hour after feeding on the chafers, and death may follow in 1 hour after the appearance of symptoms. If sufficient poison is not absorbed to cause death, the bird recovers. The affected chicken becomes drowsy, shows weakness of the legs, and falls over on its side. There may be convulsions. Sharp cries are frequently emitted, and the head and neck are retracted over the back of the bird. The only evidence of the disease is the presence of rose chafers in the crop.

Treatment.—The rapid action of the poison renders treatment futile in birds showing symptoms. When the nature of the trouble is realized, other birds in the flock which had opportunity to eat chafers should be given Epsom salts in the proportion of one-fourth of a teaspoonful, mixed with a small quantity of feed, to each bird. Preventive measures consist in keeping young chickens in enclosed runs or at points where they will not have access to grapevines, rosebushes, and shrubbery when the insects are prevalent. This corresponds somewhat closely to the time of first blossoming of the various garden flowers. Destruction of the beetles should be practiced by spraying infected plants with one-half to three-fifths of a pound of lead arsenate to 10 gallons of water.

SALT POISONING

Chickens, turkeys, pigeons, and other species of fowl are susceptible to poisoning by common salt when large quantities are consumed at one time. Ordinarily, from one-third to one-half ounce of salt would be a fatal dose for the average chicken. Care should be taken not to leave fish brine, freezing brine, or ice-cream salt within reach of the fowls, as they may swallow sufficient quantities of the material to poison them.

Symptoms.—This form of poisoning is manifested by progressive paralysis-like symptoms accompanied by extreme drowsiness and finally death by asphyxiation due to the weakening effect of the poison upon the muscles of respiration.

Post mortem appearance.—The mucosa of the mouth is covered with a dirty viscid exudate. Evidences of congestion and ulceration appear on the mucous membranes of the esophagus, crop, and intestinal tract. The internal organs and nerve centers are more or less congested, and the blood possesses a peculiar bright red coloration.

Treatment.—There is no medicinal treatment for salt poisoning of poultry.

SUBCUTANEOUS EMPHYSEMA

Subcutaneous emphysema is a condition in which the skin of the breast and other parts of the body is distended by air, and thus separated from the underlying tissues of the bird's body. This gives the bird a peculiar puffed-up appearance. The inflated condition of the skin is immediately detected by handling the bird. Chickens, pigeons, and turkeys are susceptible to the condition.

Cause.—It is probable that subcutaneous emphysema is ordinarily caused by a rupture of one of the air sacs of the body, or other respiratory organs, which permits a leakage of inhaled air into the spaces immediately beneath the skin.

Treatment.—No medicinal treatment for the condition is known. Relief may be afforded by slitting the skin over affected areas, thus allowing the accumulated air to escape. Some cases may be reduced by exerting prolonged gentle pressure over the distended portions of the body of the bird, and in this way forcing some of the air out through the same avenue by which it gained entrance into the subcutaneous region.

TUMORS

A number of varieties of tumors occur frequently in birds. The largest percentage is found in fowls more than 2 years old. In hens the egg organs are affected in more than 50 percent of the cases. Tumors in birds have a marked tendency to break down and cause death from internal hemorrhage. Tumors on the skin are easily recognized, while internal ones may be suspected when an individual in the flock shows poor condition, increasing droopiness, or emaciation.

Treatment.—There is no treatment for internal tumors. External ones can be removed satisfactorily in some cases by surgical means. Since many of the growths, however, are of a malignant or cancerous nature, it is best to kill the bird and destroy the carcass.

PARASITES AND PARASITIC DISEASES

A number of different kinds of parasites found in poultry in the United States may seriously affect the health of the birds. These parasites may be divided into three general groups. One group, known as Protozoa, consists of organisms so small that they can be seen only with the aid of a microscope. The second group consists of worm parasites, of several kinds, all but a few of which are sufficiently large, when full-grown, to be seen with the naked eye. The third group is made up of small, parasitic arthropods, namely, certain insects (including lice and fleas), and certain mites, which include not only mites as commonly known but also ticks. The location of parasites varies greatly with the different kind of parasites; protozoa may occur

in the blood stream, in the kidneys, and in the intestines of certain domestic birds; worm parasites may occur in such varied locations as the eye, the windpipe, all parts of the digestive tract, the reproductive organs, and in or under the skin; and arthropod parasites of poultry occur chiefly on the outside of the body, either on the feathers or in or under the skin, but, on the other hand, certain mites may occur within the body, in the air passages, lungs, and liver.

METHOD OF EXAMINING FOWLS FOR PARASITES

An examination of a domestic bird for the purpose of determining whether parasites are present must take into consideration these differences in the kinds of parasites and their possible locations.

A careful examination of the skin among the feathers on various parts of the body will reveal the presence of lice and certain species of mites. Some lice are found on the feathers and some kinds of mites are to be found between the barbules of the feathers or inside the quills at the base of the larger feathers. The scaly leg mite is to be found in or just beneath the scales on the shanks or feet and in minute lesions on the comb or wattles. As regards the internal parasites, for locating protozoa, smears or sections made from infected parts of the bird must be examined microscopically. On the other hand, to locate worm parasites and the mites which occur within the body, the various parts of the body may be examined according to some such procedure as the following:

In examining a dead fowl the feathers are removed from the under side, the abdomen is carefully opened along the median line, and the breast is cut loose on each side and turned forward. The various internal organs are then carefully loosened from the tissues which hold them in place, and, after being spread out, as in figure 14, so that they can be separated and identified, they are removed from the bird. The windpipe or trachea (*a*) is cut open and its inner surface examined; the lungs (*k*) are also removed and carefully inspected. The esophagus, including the undilated part, and the crop (*b* and *c*), are slit open and the contents washed into a shallow glass dish and examined; the wall of the esophagus is examined by stretching it between the hands and holding it up between the observer's eyes and the light so that the light shines through it and thus throws into relief the outline of any worms embedded in the wall. The remainder of the digestive tract, made up of the two stomachs, namely, the glandular stomach (*h*) and the muscular stomach or gizzard (*f*), and the intestines (*g*), is next cut loose and lifted out into a dish of water. The glandular stomach or proventriculus (*h*) is opened and washed into a glass dish, and the glands are squeezed so that embedded parasites may be loosened; the wall is examined on both the inner and outer surfaces, one of the nematodes found in this location, namely, the globular, red tetramere, often showing more clearly through the semi-transparent outer surface than through the opaque inner surface. The muscular stomach or gizzard (*f*) is opened, and its contents are emptied out and examined; the horny lining is then peeled off, and the inner surface of the lining and also the newly exposed surface of the muscular wall are examined for parasites. The small intestine (*g*) and finally the ceca (*i*) are slit open in water, separately; the wall of

these organs is run through between the thumb and fingers and examined carefully during the process, in order to remove any parasites which are buried in the mucus or attached to the wall; the intestinal contents may be washed and allowed to settle several times until the water is clear, and then examined in shallow glass dishes.

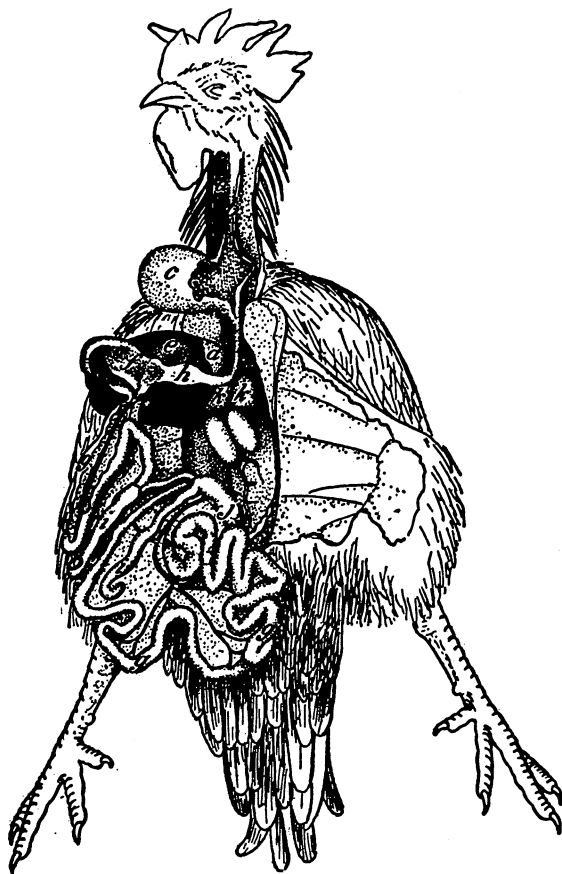


FIGURE 14.—Internal organs of fowl, which have been spread out: *a*, Windpipe or trachea; *b*, undilated esophagus; *c*, crop; *d*, heart; *e*, liver; *f*, gizzard; *g*, intestines; *h*, glandular stomach; *i*, ceca or blind guts; *j*, rectum; *k*, lungs. Adapted from Sunderville.

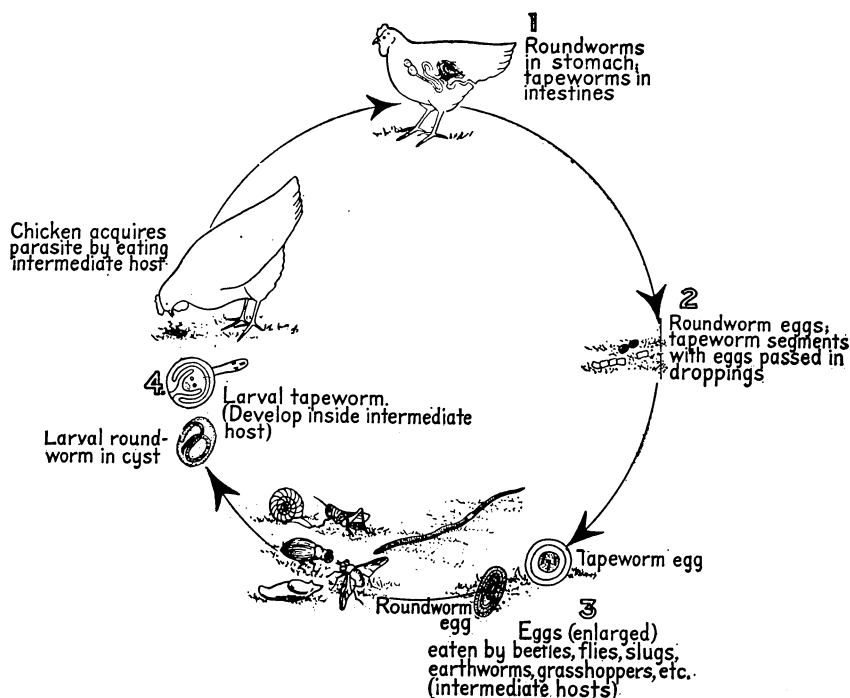
METHOD OF KILLING AND PRESERVING PARASITES

Protozoa can be found to best advantage in fresh material, and certain organisms belonging to this group can be found only in such material. Other protozoa, as the coccidia, if microscopical examination cannot be made of the intestinal contents when fresh, are recognizable on examination if the material is preserved by the addition of formaldehyde solution. Worm parasites which have been collected should be washed well in water in order to remove all mucus or other clinging material, and should then be put into a weak solution of

formaldehyde (from 2 to 4 percent), which has been warmed to the point at which it begins to steam. Material of this sort can be shipped to laboratories for identification. Arthropod parasites may be preserved in 2-percent formaldehyde solution or 75-percent alcohol. Proper labeling of preserved specimens is important. The age, breed, and other facts about the host, location within or on the fowl, the locality, date of collection, and collector's name should be given.

VARIOUS METHODS OF REPRODUCTION AND OF SPREAD OF PARASITES

The different kinds of parasites of poultry have very different life habits. A knowledge of these habits is important in understanding the diseases caused by them and in deciding on methods of checking those diseases. Protozoa, for instance, multiply within the bird's body so that one organism may give rise to large numbers of organisms (fig. 19, A). Worm parasites, on the other hand, do not multiply within the bird's body; a single egg or single young parasite which gains entrance into the body develops into only one worm, and multiplication depends on the eggs or young worms produced by such a parasite; the parasite eggs or young worms must pass out of the body and undergo more or less development on the ground or in such lower animals as insects before giving rise to additional parasites in birds. The life histories of parasitic insects and mites likewise vary widely.



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FIGURE 15.—Diagram of the various stages in an indirect life history of a tapeworm and a roundworm of poultry.

Some species, such as lice and scaly-leg mites, remain on the fowls continuously and are spread mainly by direct contact. Others, such as the common chicken mite, feed mainly at night and spend the greater part of their lives about the roosting places of the fowls.

The development of the various stages outside the bird's body differs greatly in different worm parasites. In some cases there is a direct life history; the parasite eggs which pass out of the body develop within them the young stage of the worm, which on being taken into the body of a bird will infect it and will develop to an adult parasite. In other cases the life history is indirect; the bird is known as the primary host, and the parasite eggs which pass out of its body must go into one or more intermediate hosts before again going back to a bird. An example of such an indirect life history is given subsequently with reference to one of the flukes found in birds. In the cases of indirect life histories of tapeworms and roundworms, only one intermediate host is necessary, so far as is known; the nature of the intermediate host may vary and is still unknown for some parasites, but in certain instances insects, snails, slugs, and earthworms have been found to serve in this capacity. Figure 15 gives in diagrammatic form the various steps in such a life history.

GENERAL MEASURES FOR THE CONTROL OF PARASITES OF POULTRY

Poultry houses and yards should be so placed that rain water will not wash from one to another. Marshy places should be drained, and holes in which water may collect should be filled in. Even if permanent quarters must be used to some extent, a rotation of yards is highly desirable; the ground should be plowed under and then planted to green stuff when the yard is not in use.

Roosts and nests should be constructed so that they can be readily examined and treated for mites, ticks, and bedbugs. Such arrangement also facilitates thorough cleaning and disinfection for diseases and internal parasites. Keeping under control flies that may carry poultry diseases or internal parasites is important. This is accomplished by preventing flies from breeding in manure and by using fly traps and sprays.¹⁰

As the most severe damage from parasites occurs in young birds, special precautions should be taken to protect the young. They should be raised away from the older birds, which are often carriers of parasites, and from the infected areas occupied by older birds.

As regards sanitation, feed and water should be given in containers which will not allow contamination of the contents with the birds' droppings. The frequent removal and disposal of droppings are likewise important preventive measures. Disposal should be effected by a method which will keep the droppings with their content of worm eggs and protozoa not only from the chickens but also from the intermediate hosts of the parasites and from wild-animal life which may serve as carriers in one way or another. It is advisable to keep yards free from boards and miscellaneous objects, since they may harbor such intermediate hosts or carriers. Filling in or draining low, damp areas which may breed such intermediate hosts, and the screen-

¹⁰ For information on fly control see Leaflet 182, Housefly Control, Circular E-675, Use of DDT in control of flies on cattle and around buildings.

ing of houses are also of value in this connection. A screen, to be effective, should have a mesh small enough to keep out even such small insects as the smaller dung beetles.

The practice of using chicken manure as fertilizer is dangerous from a poultry standpoint, if the manure is spread in places where chickens will have access to it or in places where small animal forms may feed on it and may serve as intermediate hosts or as mechanical carriers to convey parasites back to the poultry. The danger is lessened if the chicken manure is stored in a manner that causes it to heat. The development of heat in the chicken droppings during storage tends to destroy worm eggs and other harmful organisms. Lack of oxygen also aids in this destruction.

A method of storage for horse manure which produces sufficient heat to destroy worm eggs has been worked out by the Bureau of Animal Industry and used with very satisfactory results; this method would probably be applicable to poultry manure. A double-walled, double-floored, wooden box, with sawdust between the double parts of the walls and floors for insulation, and with a tight cover to hold the heat, was found to be the best kind of storage; all parasitic-worm eggs were destroyed in a period of 2 weeks in horse manure stored in this manner. It is a common practice to store chicken droppings in barrels. If the barrels have tight covers and suitable external insulation to hold the heat, droppings which are not dried by the addition of sand or similar material may be expected to heat to the point where parasitic material will be destroyed.

DISEASES CAUSED BY PROTOZOA

Blackhead (Enterohepatitis)

Blackhead is primarily a disease of the ceca and liver, but the fact that the head of the affected bird may become discolored has given it its popular name, blackhead. It is most frequently seen as a disease in turkeys, but chickens also are susceptible. Ruffed grouse, bob-white quail and other gallinaceous game birds likewise have been found to suffer from the disease.

Cause.—The parasite (*Histomonas meleagridis*) causing blackhead is one of the Protozoa. The organisms live part of the time free in the cavity of the ceca, or blind guts, but in another stage of the disease they apparently enter the walls of the ceca and are probably carried through the blood stream to the liver. The organisms in the ceca multiply in large numbers and pass out in the droppings.

Spread of the disease.—Young and adult chickens may contract this disease, but although in some outbreaks they may die in considerable numbers, they more usually recover promptly. However, in spite of their recovery, they remain carriers of the parasites, which are discharged in their droppings in vast numbers. These organisms may infect other birds, either chickens or turkeys, if picked up by them in contaminated feed or water. The realization that turkeys may die, in large numbers, of blackhead contracted from chickens which have the disease in so mild a form as to show no evidence of it has led to strong emphasis being placed on the recommendation that turkeys be kept away from chickens.

It is probable that the parasite which causes blackhead was originally brought to North America in chickens from Europe and that it was passed on to turkeys in this country, thus introducing a new disease to which turkeys were more susceptible than were chickens, which in the course of time had become resistant to it.

Another highly important factor in the spread of the blackhead disease is the part played by the common cecum worm (*Heterakis gallinae*) of chickens and turkeys. The worms in the ceca of a fowl which is infected with the blackhead organisms may carry these organisms in their bodies; the eggs of the worms, which are passed out in large numbers in the droppings of the fowl, presumably carry these small blackhead parasites with them. When the eggs are eaten, in contaminated feed or water, by a fowl and hatch in the intestinal tract the blackhead organisms are transmitted to the bird and set up the disease. The protozoan parasite, being thus included within the shell of the worm egg, is protected from heat, cold, dryness, and other adverse conditions which would otherwise destroy it. The worm eggs, which are resistant to such factors because of their thick shells, can hold the blackhead organisms in the soil from one year to another unless exposed to zero weather, whereas it has been found that the blackhead organism itself, without such protection, seldom survives for more than 24 hours outside the body of the fowl.

Symptoms.—The disease may occur at any time in the life of a turkey, but is most serious in young birds. Droopiness, loss of appetite, an invariable loss of weight, and sometimes a sulfur-colored diarrhea are the main symptoms. The discoloration of the head, which has given the disease its name, is seen also in other diseases and is not always present in this disease, so that the term "blackhead" is not a very satisfactory term. Death may occur suddenly.

Internal changes.—An examination of the turkey after death shows the ceca, or blind guts, enlarged and filled with a solid, yellowish, cheesy mass which sometimes contains blood; the walls of the ceca may have areas which are roughened and thickened. In addition to the changes in the ceca, the liver is usually affected, it is sometimes enlarged and often spotted with dark-red, gray, or yellow circular areas, which are usually depressed below the surface rather than raised above it (fig. 16).

Treatment.—Although many drugs have been tried and some are recommended for the treatment of blackhead, none have been found to be of practical use. The only practical, general procedure consists in the use of control measures to prevent the development of the disease.

Prevention.—Since, as explained above, the chicken may act as a carrier of the parasite causing blackhead disease, turkeys should be kept completely removed from chickens or land ranged by chickens or fertilized with chicken manure. In addition the best results are obtained with artificially reared birds—that is, those hatched in incubators and brooded artificially. The poults should be kept first in coops, houses, or runs that can be easily cleaned, and later on pasture that is known not to have been ranged by chickens and preferably not to have been used for older turkeys. The University of California has found losses among such artificially reared turkeys to be

much less than among those reared under the old system. At the North Dakota Agricultural College, blackhead was prevented by placing poults, when 6 to 8 weeks old, on a rearing ground, fenced and cross-fenced to provide 4 runs, for monthly rotation; houses and fences are portable and are moved yearly for a 5-year rotation system.

Since cecum worms spread the blackhead parasite, the phenothiazine



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FIGURE 16.—Enterohepatitis (blackhead). Liver of turkey, showing necrotic areas.

mash treatment recommended on page 81 for the removal of these worms should begin when the turkeys are placed on the ground. There are reports that losses from blackhead have been considerably reduced in this way. After each treatment, removal of the turkeys to clean quarters is necessary to prevent reinfection. Other treatments for cecum worms are given in this bulletin (p. 82). Any turkeys which show symptoms of the disease should be promptly removed and isolated, and those which have died should be buried.

Coccidiosis

Cause and nature of the disease.—For many years it was thought that minute protozoan organisms known as coccidia, found in a large variety of birds, both domestic and wild, were all the same species (*Eimeria avium*). More recent studies, however, have revealed that there are at least eight species of coccidia in chickens alone, the diseases caused by them varying in location and intensity. One species (*E. mitis*) ordinarily produces no noticeable damage to the intestinal wall and does not seriously affect the health or growth of the chicken; at other times it is distinctly injurious. Another species (*E. tenella*) which is found in the blind guts, or ceca, of the chicken (fig. 17) affects the health of the bird very decidedly, producing the symptoms of coccidiosis as they are most widely known among poultry raisers. This is the acute form which is often seen in baby chicks during the first few weeks of life; the coccidia invade the wall of the gut and often produce extensive hemorrhages, blood being noticeable in the droppings. Other symptoms, which in fact may appear earlier than the bloody droppings, are ruffled feathers, pallor, and rapid wasting. Chicks up to 2 months of age may die very suddenly and in large numbers as a result of this form of the disease (fig. 18).

A serious intestinal form of coccidiosis may be caused by another species (*E. acervulina*); the organisms in this case live chiefly in the upper part of the small intestine, producing whitish or grayish spots in the wall. Extreme emaciation or wasting of the fowls in severe cases is the principal characteristic of this form of coccidiosis.

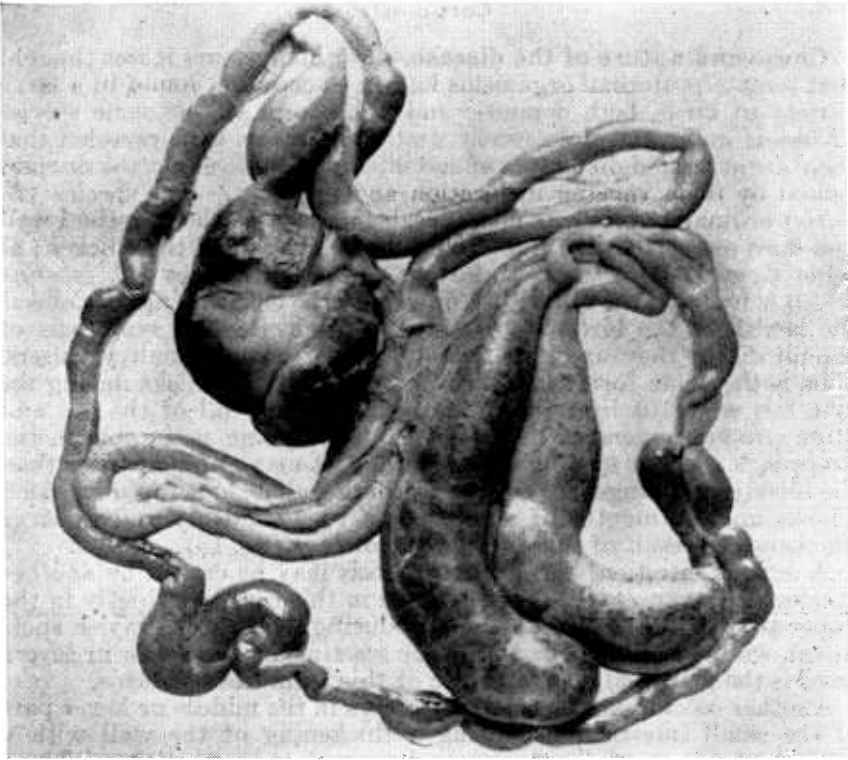
Another coccidium (*E. maxima*) occurs in the middle or lower part of the small intestine, producing a thickening of the wall with a variable amount of hemorrhage; however, the quantity of blood passed in the droppings is never so great in this disease as in that involving the ceca. In severe cases of this type, pallor, roughening of the feathers, and diminished appetite result.

E. praecox, *E. hagani*, *E. brunetti*, and *E. necatrix* occur in the small intestine. The last two are pathogenic and produce severe hemorrhage.

Turkeys may be infected with coccidia (*E. meleagridis* and *E. meleagritidis*) species different from those found in chickens. Although outbreaks of coccidiosis occasionally occur in young turkeys, the disease is apparently not so severe in these birds as it is among chickens. It is probable that the young poults develop an immunity to the organisms at an early date, as turkey poults may show the presence of these coccidia within the first week after hatching, but may not appear to be injured by them.

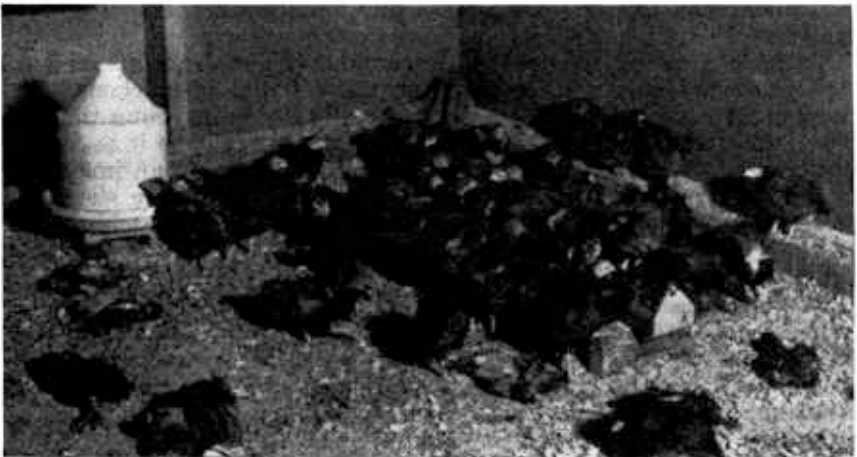
Pigeons are also parasitized by one of the coccidia (*Eimeria lab-beana*); the disease produced may be rapidly fatal or may be chronic. In geese, coccidia produce a disease of the kidneys which may weaken them so greatly that they are unable to walk; the birds become progressively weaker until they die. Ducks may suffer severely from an intestinal form of coccidiosis. There is evidence that a species of coccidium is usually limited to one kind of bird.

Method of contracting the disease.—In all forms of coccidiosis the disease is spread by contamination of the feed, water, and soil with the droppings of fowls which harbor the parasites. The coccidia



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FIGURE 17.—Intestinal tract of chicken showing symptoms of coccidiosis, cecal type. Note the two enlarged, blood-filled ceca or blind guts.

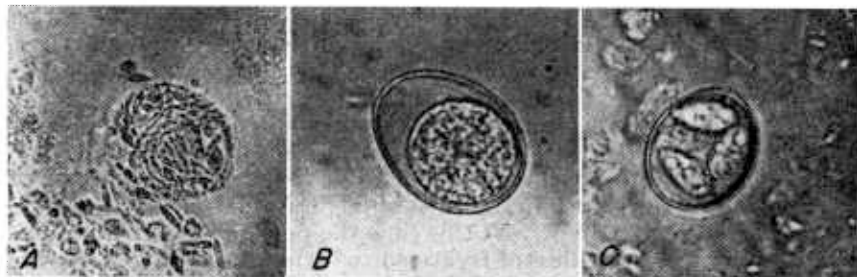


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FIGURE 18.—Young chickens suffering from coccidiosis, cecal form.

pass through certain stages of development in the outside world (fig. 19 *B* and *C*); later, when taken into the body of a bird in the act of eating or drinking, the organism continues its development, multiplying in large numbers (fig. 19, *A*).

As regards the transmission of coccidia to young birds through the egg, it appears never to have been demonstrated that the organisms may be included in the egg at the time it is formed. Even if such transmission were possible, it is improbable that it would happen frequently; it is much more likely that the organisms would be on the outside of the egg, the contamination of the eggshell occurring as the egg was passing out of the cloaca and vent. However, critical investigations have shown that the coccidia on the eggshell were not able to survive the incubation of the eggs. It is probable that coccidiosis is contracted by the young chicks much more frequently by other means than by transmission through or on the egg.



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FIGURE 19.—Various stages of development of organisms which cause coccidiosis: *A*, Manner in which one organism gives rise to a large number of organisms in cecum of fowl; *B*, organism as passed in the droppings of fowl; *C*, organism which has developed to a stage which will infect the fowl. (After Johnson.)

The organisms may be carried for considerable distances in running water or in dust, or on shoes, grain sacks, or other objects, or may be spread by birds or by flies or other insects which fly from one poultry yard to another; rats and mice also probably serve to spread the organisms. It has been found that a single organism is capable of producing a mild form of the disease, the organism multiplying in the chick's body and considerable numbers of the parasite later being passed in the droppings, so that as a result the infection is capable of spreading to the other chicks. It is apparent, therefore, that there are many ways in which a small amount of the disease-producing material may be spread.

Post mortem findings.—The changes which will have taken place in the intestines of birds affected with intestinal coccidiosis will depend largely on the species of coccidia present, as noted above. In the acute form of coccidiosis in which the site of infection is in the blind guts, or ceca, these organs usually appear enlarged and filled with blood, and may be plugged with a thick core—a yellowish, cheesy substance with dark bloody areas in it.

Immunity.—There is ample evidence to show that chickens which have suffered an attack of coccidiosis are subsequently immune to the species of coccidium that was responsible for the attack but are not

immune to other species. It has also been shown that daily administrations of a few thousands of *E. tenella* oocysts per day for several days produced immunity which lasted for several months. The fact that there is a lack of coccidiosis on some farms may be explained on the hypothesis that a continuous ingestion of small numbers of oocysts is sufficient to protect the birds against a heavy infection. Birds immunized in this way usually manifest few or no noticeable symptoms of coccidiosis, and this is why older birds are more resistant to this disease than younger ones. This discovery seems to contradict the previous belief that the most effective method for controlling coccidiosis was to exercise every precaution to keep the flock coccidia-free.

Treatment.—Many treatments have been tried and advocated for coccidiosis, but none have been entirely satisfactory. Recent studies have indicated that the most practical method for the control of coccidiosis is to maintain coccidial infections at a minimum level until natural resistance or immunity is established. This can often be accomplished through good management and sanitation. However, there are times that, regardless of good poultry-husbandry practices, this disease, in one way or another, creeps in. When coccidiosis does appear, quick action is needed to check it.

For flock treatment, some of the recently introduced sulfonamid drugs have proved helpful. However, if these drugs are to be of value they must be administered early in the infection. After symptoms of coccidiosis have developed in the individual bird, there is nothing much that can be done to help it. At this time the peak of the infection has been reached and regardless of treatment whether the bird will recover or die depends on the severity of the infection.

Prevention.—Extensive studies of coccidiosis have brought to light two important facts: (1) That the severity of the disease depends on the number of organisms which are taken into the body of the fowl, and (2) that the disease runs a limited course. In nonfatal cases the fowls recover, and the organisms usually disappear within a few weeks, unless reinfection has taken place. Control measures which take these facts into consideration are therefore indicated.

Although there has been little success in the medicinal treatment of coccidiosis after it has fully developed in individual birds, measures can be taken to prevent the development of the disease in chickens and to reduce its injurious effects if it appears. Strict sanitation, as described below, will reduce the intake of organisms. A well-balanced nutritious diet will help to build up the resistance of the fowls, but is not a cure for the disease.

Daily cleaning is highly advisable, in order that the organisms which are being passed in the droppings may be prevented from developing to the stage which is infective. As a disinfectant for houses, a 2- to 4-percent solution of liquor cresolis compositus or other coal-tar cresotes used in strong, hot solutions is helpful. Ammonia fumigation has been described as being successful in destroying oocysts in poultry houses in a very short time. When applied at the rate of 3 ounces for each 10 cubic feet of space, ammonia is very effective. As the coccidia are very difficult to destroy, cleanliness and the frequent removal of droppings containing the infectious material are highly important, and disinfectants must be regarded only as aids in connection with cleaning up. Coccidia need moisture for their de-

velopment; hence thorough drying checks this development. They are susceptible to high temperatures also, boiling water destroying them quickly and hot water of somewhat lower temperature more slowly (a temperature of approximately 130° F. kills them in about 30 minutes). Practical measures based on these principles include: (1) The application of a layer of slaked lime to the ground; (2) putting feeding troughs and drinking vessels into boiling water at frequent intervals; (3) burning carcasses of fowls which have died of the disease; and (4) burning or removing to remote areas the litter or other refuse which may be contaminated with infected droppings.

Strictest precautions should be taken to prevent the contamination of feed supplies while they are being mixed and subsequently while being stored; they should be protected from flies and mice and from the dust of poultry houses or runs.

Rearing chicks on raised wire-mesh floors, through which the droppings will fall, is probably the most effective preventive measure, but birds reared in this way must be kept away from infection subsequently, as they do not have the acquired resistance of birds which have passed through an attack of coccidiosis in early life. Whatever the system of rearing, avoidance of crowding is highly important. The screening of houses and runs in order to keep flies out and thus prevent their spreading the organisms is also of value.

Studies on the influence of feeding habits on the severity of cecal coccidiosis have been carried out. These studies indicate that birds that have access to feed at all times are somewhat more resistant to coccidiosis than birds fed intermittently.

Many poultrymen are now using the "deep litter method" of rearing birds. There is some evidence to show that such litter, if kept dry, reduces the potential number of sporulated oocysts through drying. As more litter is placed on the old, there is undoubtedly brought about a mechanical dilution of the concentrations of oocysts as they are passed by the birds, thus reducing in general the size of the infective dose and consequently the severity of the ensuing infection and probably immunity.

It has been shown that certain drugs are effective in preventing coccidiosis if administered before the birds are exposed to infection. Flowers of sulphur given at a level of 2 percent by weight beginning 2 or 3 days before the birds are turned out on the ground will aid in preventing cecal coccidiosis. Some of the birds will contract the infection at this level, but the mortality resulting will be low and the majority of the surviving birds will be immune to subsequent attacks. Sulfaguanidine when incorporated in the feed at a level of 0.5 percent by weight and given intermittently or continuously has given satisfactory results in the prevention of the disease.

Two methods of administration of the sulfonamid drugs are practiced. When only a few birds are infected, and those only mildly, the usual treatment is the intermittent system. This method consists of feeding the medicated mash or water for 1 or 2 days beginning at the first signs of the disease, then regular mash and plain water for the following 3 days, followed by medicated mash or water again on the sixth day. If the birds are still off feed and do not show the proper improvement, medicated mash or water is given again on the tenth day. The other method is known as the continuous method.

It is usually advocated only when a large number of birds in the flock show symptoms of the disease. Medication is usually administered only for 3 or 4 days.

Investigations have shown that sulfaguanidine, sulfadiazine, sulfamerazine, and sulfamethazine when added to the regular mash are effective in reducing the severity of the infection. Sulfaguanidine is generally used at a level of 1.0 percent by weight and each of the other sulfa drugs at 0.5-percent level. A 0.2-percent solution of sodium salt of either sulfamerazine or sulfamethazine when substituted for the regular drinking water and administered intermittently or continuously for the periods stated above, is also recommended for the alleviation of coccidiosis. More recently, sulfaquinoxaline has been shown to have a similar action against coccidiosis as the above-mentioned sulfa drugs when added to the mash in an 0.05-percent concentration and fed intermittently or at a level of 0.0125 percent by weight and fed continuously.

It is very important that the drug be mixed thoroughly with the mash. To make a uniform mixture, the correct amount of the drug is first mixed with a small amount of the mash; then this mixture is incorporated in the remainder of the mash.

All the sulfonamid drugs are more or less toxic and, therefore, medication should not be continued longer than is generally recommended.

Trichomoniasis

A group of flagellated protozoan parasites, collectively known as trichomonads, are commonly found in the digestive tracts of barnyard fowls; however, only turkeys, chickens, and pigeons have been known to develop symptoms following infection with these parasites.

On the basis of location within the alimentary tract and distinct differences in the pathological pictures resulting from infections, two forms of trichomoniasis in poultry have been recognized, one involving the upper digestive tract and the other the lower digestive tract.

TRICHOMONIASIS OF THE UPPER DIGESTIVE TRACT

Cause.—Owing to the difficulty in classifying the organisms, several different species of trichomonads have been identified as associated with the formation of caseous lesions in the esophagus and crop of domestic fowl. One species (*Trichomonas diversa*) has been reported to be the cause of trichomoniasis of the upper digestive tract of turkeys. Another species (*Trichomonas columbae*) is said to produce lesions in the esophagus and crop of the pigeon. The lesions with which this parasite has been associated are similar to those attributed to *Trichomonas diversa* of the turkey. A third species (*Trichomonas gallinae*) has been identified as the cause of the formation of similar lesions in the upper digestive tract of the chicken.

Because of the similarity of location and the results of cross-infection experiments, as well as morphological studies, it has been suggested that the organisms associated with lesions of the esophagus and crop of the turkey, chicken, and pigeon may be the same species (*Trichomonas gallinae*), and that the pigeon may be the source of infection.

Spread of disease.—Infection of new hosts apparently occurs through ingestion of contaminated feed, soil, or drinking water with the parasites which have been discharged from the infected birds in either the droppings or discharges from the mouth.

In pigeons the infection is probably passed directly from the parent to the squab during the act of feeding.

Symptoms.—Turkeys affected with trichomoniasis of the upper digestive tract are depressed, show a loss of appetite, sagging wings, emaciation, and drooling at the mouth. The droppings are usually watery and contain large numbers of the flagellated parasites. Young birds may die as early as 1 day following the appearance of symptoms, but older birds may linger for several weeks before succumbing. In older birds the region surrounding the crop usually appears depressed and sometimes pendulous. Although certain other diseases may produce similar symptoms, birds that make repeated attempts to swallow and show extension of the head and neck and retention of the crop fluid should be suspected of being affected with this form of trichomoniasis.

Most adult pigeons harbor the parasite and never show any symptoms of the disease. On the other hand, the infection may run a rapid course and result in the death of the bird. In such cases, both in squabs and in adults, there is an accompanying catarrhal condition, the eyes and the nostrils water, the bird experiences extreme difficulty in breathing, and dies within a short time.

Internal changes.—In the chicken and turkey the disease is characterized by the presence of peculiar, cheesy lesions, somewhat resembling those resulting from fungus infection, on the surface of the mucous membranes of the crop and esophagus (fig. 20). In severe infections, the mucous membrane is entirely destroyed. Lesions have never been found in the proventriculus or any organ posterior to it. It has been suggested that perhaps the gastric juice of the proventriculus or glandular stomach may destroy the trichomonads.

In the pigeon, the earliest visible lesions appear in the mouth cavity when the squab is about 1 to 2 weeks old. If this condition is not promptly treated or the lesions carefully removed, it will spread rapidly until the bird is unable to eat, then to breathe, and dies from starvation or suffocation. The lesions of the disease also occur in the throat, the esophagus, the liver, the pancreas, and, in one instance, in the heart. The disease may manifest itself in the form of a large, solid lesion (resembling a boil) in the region of the navel in very young squabs.

Prevention.—Isolation of sick birds, rotation of feeding grounds, clean water and rigid sanitation have been suggested as of value in preventing the spread of the disease. Since adult birds may be carriers of the parasites, the young birds should be kept separated from the older fowls.

Since flies may be one means of spreading trichomoniasis, the control of these insects is important. Artificial incubation and brooding, and rearing the young birds on clean ground are recommended.

Treatment.—No satisfactory treatment is known. The use of copper sulfate, 1 teaspoonful in 5 gallons of water, as an aid to sanitation has been recommended. Recent experiments conducted by the United States Bureau of Animal Industry show that breeding pigeons



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FIGURE 20—Trichomoniasis of the upper digestive tract of a turkey. Crop showing small cheesy lesions on mucous membrane. (After Bushnell and Twiehaus, 1940.)

were cured of the disease by substituting for the regular drinking water an aqueous solution of copper sulfate prepared by adding 35 milligrams of copper sulfate crystals to 100 cc. of water (1.4 grams per gallon of water). This solution is kept before the birds at all times until a cure is effected in both the parent bird and in the squab.

TRICHOMONIASIS OF THE LOWER DIGESTIVE TRACT

Cause.—Another trichomonad (*Trichomonas gallinarum*) is regarded as the cause of a disease of the lower digestive tract of turkeys, involving the ceca and liver. This protozoan is commonly found in the ceca of turkeys and other barnyard fowl, but only turkeys are known to develop pronounced symptoms following infection.

Spread of disease.—Birds contract the disease through the ingestion of feed, water, or soil contaminated with droppings from infected birds.

Symptoms.—The disease is characterized by loss of appetite, foamy cecal contents, weakness, and occasional deaths in young turkeys. Older turkeys show gradual and progressive evidence of unthriftiness accompanied by droopiness. Such birds may live for several weeks. It has been observed that birds affected with trichomoniasis showed vitamin A deficiency.

Internal changes.—Young birds may not show any visible lesions.

In older turkeys, the liver is sometimes covered with irregularly outlined, cream-colored areas of necrosis which appear granular and usually slightly elevated above the surface of the liver tissue (fig. 21). The ceca, or blind guts, are usually enlarged and filled with foamy cecal contents. When present, the liver changes are similar to those of blackhead caused by *Histomonas meleagridis*. However, the exact role of trichomonads in the formation of liver lesions still remains to



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FIGURE 21.—Trichomoniasis of the lower digestive tract. Liver of turkey showing necrotic areas.

be determined, although observations have shown that the causative agents of both trichomoniasis and blackhead (histomoniasis) may be associated in the same liver and even in the same liver lesion (fig. 22).

Prevention.—This is similar to that for trichomoniasis of the upper digestive tract.

Treatment.—Flock treatment with a diet containing a high percent of vitamin A has been helpful in controlling this disease. The Missouri Agricultural Experiment Station has recommended the following mixture: Two pounds of baker's yeast or other forms of live

yeast to 100 pounds of ground whole oats. Enough water is added to this mixture to make a thin paste. It is then placed in a warm place and allowed to ferment over night (12 to 15 hours). After fermentation has taken place, 5 pints of high-grade codliver oil, or 1 pint of high biological-essayed fish oil (3,000 international units of vitamin A per gram) is added and mixed thoroughly. The mash is then fed to the birds, giving them all they will eat in 20 or 30



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FIGURE 22.—Liver of turkey showing lesions typifying a mixed infection of trichomoniasis and histomoniasis.

minutes. Cleanse and rinse the feeders thoroughly after each feeding to control flies. This fermented mash is fed to the birds three or four times a day for a week or 10 days or until the poults show a marked improvement. The regular starting or growing mash should be kept before the birds at all times. No more fermented mash than the birds can consume in 1 day should be mixed up at any one time. If the birds do not eat the mash freely, add enough dehydrated alfalfa leaf meal to make a crumbly mixture. In case the birds are too weak to eat without aid, enough water or skim milk may be added to a portion

of the fermented mash to form a thin mixture and force-fed with a bulb syringe. Only an amount of the mixture sufficient to fill the crop at any one time should be given the bird, but it should be fed several times a day until recovery is sufficient for it to eat normally.

For the treatment of advanced cases of trichomoniasis, workers at the Missouri Agricultural Experiment Station have recommended gentian violet as a supplement to the fermented mash. The drug is administered preferably as enteric coated tablets in dosages ranging from $\frac{1}{16}$ grain for poults weighing 1 pound to $1\frac{1}{4}$ grains for birds weighing 12 pounds.

Birds affected with *Trichomonas gallinarum* have been successfully treated by means of fever therapy. For treatment, the infected birds are placed in a thermostatically controlled box for from 1 to 2 hours, depending upon the condition of the bird. By maintaining an air temperature of approximately 104° F. and a relative humidity of 60 to 70 percent inside the cabinet, the temperature of the bird is elevated 2° to 6°. Treatments are administered every other day until three have been given which are usually sufficient to check the disease. However, six treatments are sometimes necessary in more advanced cases of the disease.

Birds recovering from the disease following treatment behave like normal birds. Post mortem examinations of birds at different times following treatment showed that the liver lesions were either in the process of healing or practically healed.

Although the above treatment has been found to be very effective in treating birds affected with trichomoniasis, it is harmful to birds suffering from histomoniasis or blackhead. Such treatment, therefore, must not be recommended for birds infected with *Histomonas meleagridis*, the causative agent of blackhead, or birds infected with both blackhead and trichomoniasis organisms.

Hexamitiasis, or Infectious Catarrhal Enteritis

Cause and nature of disease.—A protozoan parasite (*Hexamita meleagridis*) has been reported as associated with an intestinal inflammation of young turkeys in California, Connecticut, Illinois, Indiana, Massachusetts, Missouri, New York, North Dakota, Oregon, Utah, and Washington. Another species, *Hexamita columbae*, has been reported from pigeons in the United States. The disease which has been designated as infectious catarrhal enteritis is primarily an acute infection of the upper part of the small intestine of turkey poults between the ages of 1 and 12 weeks, with greatest death loss occurring at 3 to 5 weeks. Mortality from acute outbreaks occurs in from 7 to 10 days following the first appearance of symptoms; however, there are occasional deaths for as long as 3 weeks. The death rate varies from 20 to 90 percent.

As the name implies, infectious catarrhal enteritis indicates that the disease is an infectious, intestinal inflammation characterized by abnormally heavy secretion from the mucous glands of the affected intestine.

Spread of the disease.—Infectious catarrhal enteritis is spread primarily by the adult carrier bird. The adult turkey has been shown to be the primary source of infection. The causative agent of this

disease has been experimentally transmitted from the turkey to the quail and vice versa, and data are available to indicate that the quail may also serve as a carrier of the infection.

Symptoms.—Affected birds are listless and droopy, walk with a stilted gait, and void watery or foamy droppings. They continue to lose weight in spite of the fact that they continue to eat. If the birds are suffering from an acute infection they may die within a few days after symptoms appear. Lightly infected birds usually survive an attack of the disease, but may become carriers of the organism.

Prevention.—Artificial incubation of eggs is highly recommended to eliminate the possibility of carrier hens transmitting the organism to young birds at the time of hatching. The brooding quarters must be completely isolated from the breeding quarters in order to reduce chances for acquirement of infection by the young stock. Care should be taken to see that the attendant does not spread the disease on his shoes and clothing. The feeding and watering equipment should be arranged so that the attendant can fill them with feed and water without entering the pens.

Treatment.—No effective treatment has been developed.

Bird Malaria

Several species of birds, including turkeys, ducks, and pigeons are susceptible to malarialike diseases caused by the blood protozoan parasites. These parasites invade the blood corpuscles and so modify the appearance of the host cells that the identity of the latter is completely lost.

TURKEY AND DUCK MALARIA

Cause.—Blood protozoa identified as *Leucocytozoon* spp. have been reported as responsible for considerable losses among turkeys and ducks in the United States. One species (*Leucocytozoon smithi*) has been the cause of losses ranging from 10 to 50 percent of all young turkeys in an affected area; this parasite occurs also in wild turkeys. Another species (*Leucocytozoon anatis*) has been reported as causing tremendous losses among both wild and domestic ducks in the Great Lakes region. These parasites destroy the blood cells of their hosts.

Spread of disease.—Recent studies indicate that blackflies (*Simulium* spp.) are necessary for the successful transmission of the parasites from one bird host to another. These flies ingest the parasites while sucking blood. In the engorged blackflies, the leucocytozoa multiply and, within a few days, reach the infective stage. When these infective stages of the organisms are introduced into susceptible hosts they parasitize the blood corpuscles.

Symptoms.—The general symptoms are common to both kinds of birds regardless of the species of organism causing the disease. In young birds the disease strikes suddenly, with acute symptoms lasting only 2 or 3 days. Affected birds lose appetite, become droopy, and have a tendency to lie down. Birds in the final stage of the disease move with difficulty and, if unduly excited, may fall over into a coma and die. Birds naturally recovering from the disease may remain carriers of the organisms for several months and are a

source of infection for other birds. Infected male birds rarely strut, and pay little attention to the females.

Internal changes.—The liver is usually enlarged, with cirrhosis and icterus present. The heart is sometimes enlarged, with a marked diminution in the thickness of the walls. The most characteristic lesion in ducks is an enlarged and blackened spleen.

Prevention.—Such measures as may be designed for the successful prevention of malaria in ducks and turkeys must take into consideration the following: (1) Rearing of birds in areas free from blackflies; (2) regular examination of blood smears of adults and young birds for the detection of carriers and the subsequent removal of these birds from the flocks; (3) raising of birds in confinement in houses screened against blackflies.

Treatment.—At present, no drug or drugs can be recommended for the treatment of birds suffering from leucocytozoon disease.

PIGEON MALARIA

Cause.—A protozoan parasite (*Haemoproteus columbae*) which lives in the blood of pigeons, invading the red blood corpuscles, is the cause of pigeon malaria.

Spread of the disease.—Pigeon malaria is spread by the pigeon fly (*Pseudolynchia canariensis*) the latter being necessary for the transmission of the parasite from one bird to another. The fly in biting takes in the parasites with the blood of the bird; the parasites multiply and develop within the insect's body and are then introduced into a bird by the bite of the fly.

Symptoms.—The destruction of the red cells by the parasites may cause anemia, a condition in which the blood becomes less red, this in turn lowering the vitality of the birds. Aside from this there are no marked symptoms.

Prevention.—Prevention consists in the destruction of pigeon flies. The Bureau of Entomology and Plant Quarantine recommends a thorough cleaning of the pigeon nests at intervals not to exceed 25 days, using a light spray of kerosene extract of pyrethrum in the interior of buildings, and one of the following procedures: Dusting the squabs and pigeons with fresh pyrethrum powder, derris powder, or tobacco powder containing about 6 percent of nicotine; dipping them with either an aqueous extract of pyrethrum with soap or derris extract with soap and water; or using the kerosene extract of pyrethrum spray on the birds.

WORM PARASITES AND THE DISEASES CAUSED BY THEM

Flukes

Flukes are small, flat worms, more or less resembling a leaf in shape. Their life histories always involve at least one intermediate host and sometimes two. There are two different kinds of flukes which have been found to cause disease in poultry in the United States and, although they are as yet rare in occurrence, they should be kept in mind as of possible importance in the future.

FLUKES CAUSING INJURY TO THE EGG-FORMING ORGANS

Parasite and the damage produced by it.—One species (*Prosthogonimus macrorchis*) reddish in color and about a quarter of an inch long, occurs in chickens in Michigan, Wisconsin, and Minnesota. Such flukes usually occur in the cloacal region, but they may invade the egg ducts and ovaries, causing serious injury to those organs. The symptoms shown by the fowls are dullness, loss of weight, and pallor; egg production is greatly decreased. In Europe, closely related parasites cause serious losses among chickens, ducks, and geese. The fluke occurs always near lakes or marshy places, such an environment being essential in its life history. It may occur in eggs laid by infected hens.

Life history of parasite.—The life history of this parasite involves snails and also dragonflies. The young worm, which hatches from the fluke egg, develops partially in the snail to a form of different appearance; then, leaving the snail as a tailed form, it swims around and is drawn into the body of the young stage of the dragonfly, which lives in the water during its early life; in the insect the parasite forms a cyst; and, when the young or adult dragonfly is eaten by the chicken the worm develops to its adult form, from which the fluke eggs pass and begin the cycle again.

The parasite has been found in wild ducks and has been produced experimentally in crows and English sparrows; it probably may be spread by them to domestic fowls.

Prevention.—Repeated doses of carbon tetrachloride, from 1.5 to 1.7 cubic centimeters of the drug, given in liquid cereal, are reported as a successful treatment for this parasite. To prevent chickens from becoming infected in an area in which the parasite occurs, the fowls should be prevented from eating dragonflies. Chickens probably capture the flies when the latter are still cold and inert in the early morning, and keeping fowls confined to their houses until the air has warmed would probably help to keep down infection. Otherwise, fowls should be fenced away from lake shores and other wet places.

THE CYSTIC FLUKE IN THE SKIN

Another fluke (*Collyrichum faba*) has been found in cysts in the skin of chickens and turkeys in considerable numbers in Minnesota. In addition to injuring the general health of the fowl, the parasites produce blisters in the skin, the disfigurement reducing the market value of the fowl.

The parasite occurs also in the English sparrow and is probably spread by that bird. The life history is unknown.

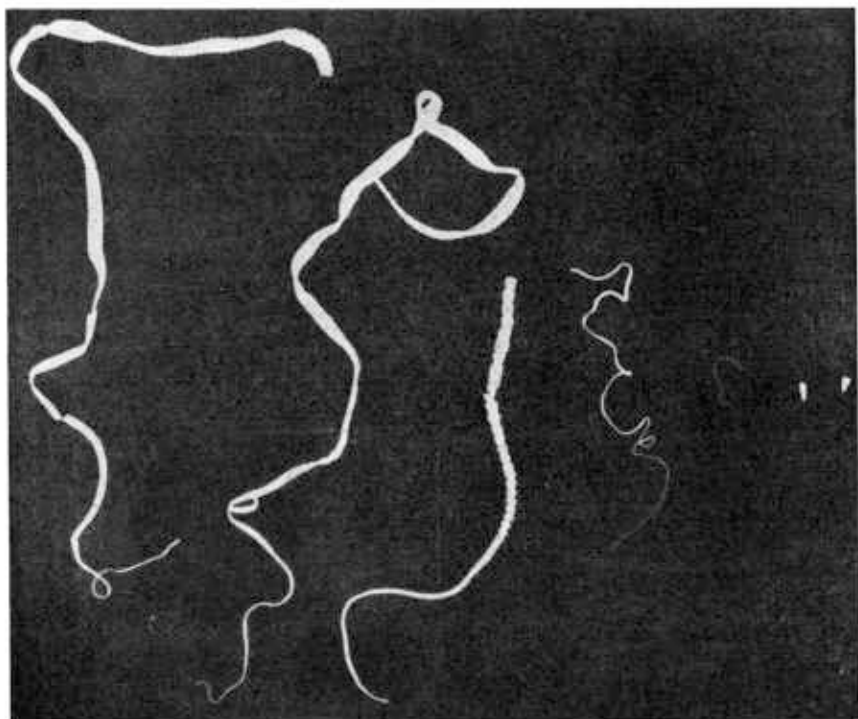
Tapeworms

Description of parasite.—Tapeworms, or cestodes, are flattened worms made up of numerous divisions or segments, following a head region by which the tapeworm is attached to the intestinal wall. The tapeworm grows at the neck region, just behind the head, so that the segments farthest from the head are the oldest ones. When the tapeworm is fully developed, the oldest segments are filled with eggs and are spoken of as ripe or gravid segments; it is these segments

which break off from the remainder of the worm and are passed in the droppings.

At least 10 different species of tapeworms are found in the United States in chickens, 9 or possibly 10 in turkeys, and several other species in the other domestic birds, such as ducks, geese, pigeons, and guinea fowls. The tapeworms vary much in size (fig. 23), some being so small that they are seen or found only with difficulty, whereas others are several inches in length.

Method of spread of tapeworms.—The life histories of tapeworms of poultry, so far as they have been definitely ascertained, indi-



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FIGURE 23.—Seven different species of tapeworms found in chickens.
Natural size.

cate that these tapeworms must pass part of their lives in an intermediate host (fig. 24). This host is some small form of animal life which is eaten by poultry, either accidentally with feed or water or actually as one of the items of feed. In the case of some of the tapeworms of poultry the nature of the intermediate host is as yet unknown, but in other cases it has been definitely ascertained that dung beetles, ground beetles, meal beetles, ants, the housefly, snails, slugs, and earthworms serve as hosts for various chicken tapeworms; grasshoppers serve as hosts for one of the turkey tapeworms.

Damage done by tapeworms.—One of the larger tapeworms (*Ral-
lietina echinobothrida*) found in chickens produces in the intestine, especially in the lowest third of its length, numerous protuberances,

or nodules, which closely resemble the nodules caused by tuberculosis. If tapeworms are attached by the head to the inner surface of the intestine at the site of the nodule, such a condition may be ascribed to the worms. If tuberculosis is also present, there will probably be lesions in the liver.

In the case of other tapeworms, however, the injury to the intestinal wall is not so marked. Loss of weight, loss of appetite, a general condition of droopiness or unthriftiness, intestinal catarrh, and diar-

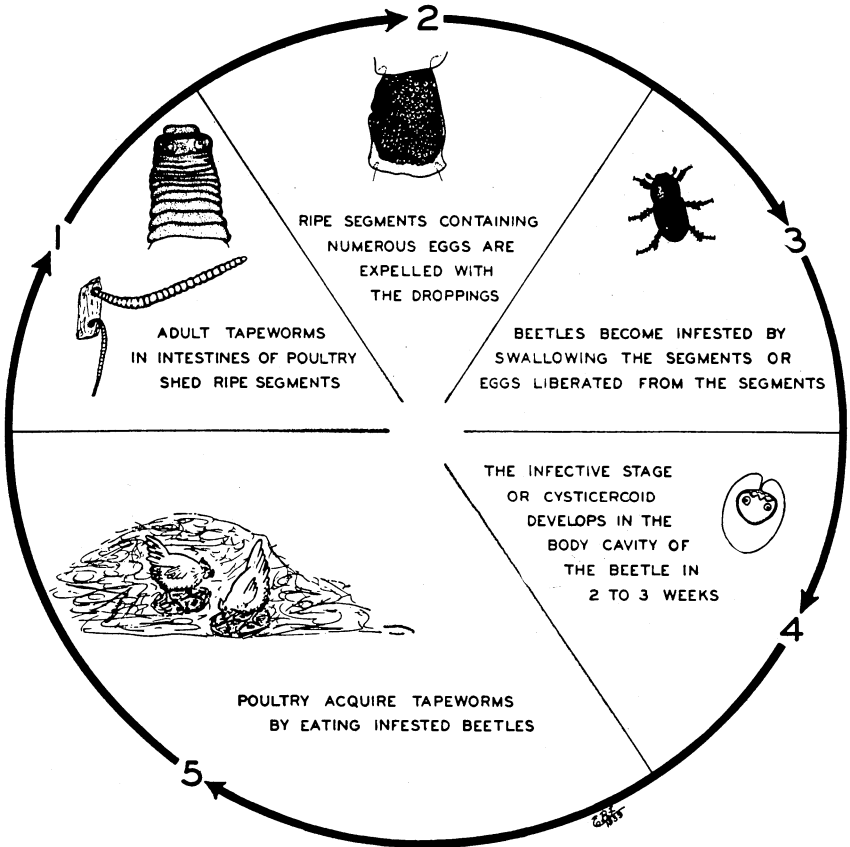


FIGURE 24.—Life history of a poultry tapeworm, *Raillietina cesticillus*.

rhea are the conditions most frequently found associated with the presence of tapeworms. Young fowls are most seriously affected. Occasionally, lameness and paralysis have been associated with heavy infestations with certain tapeworms. If these conditions are caused by tapeworms, the removal of the worms will clear up the condition, but the same conditions may be caused by other things, and the finding of tapeworms associated with these conditions does not prove that there is a connection between them.

Treatment.—There is no satisfactory drug for the removal of poultry tapeworms. Kamala was at one time considered an effective drug

for use against poultry tapeworms, but a large amount of subsequent research has shown that kamala usually exerts only a "shearing" effect, removing the tapeworm strobilae or chains of segments but leaving practically all of the many tapeworm heads. These heads produce new chains of segments, and tapeworm-egg production is renewed in 2 or 3 weeks.

The heads of some species burrow deeply, reaching points deep in the mucous lining of the intestines, or beyond this to the muscular layer, or even to the serous coat on the outside of the intestine. No drug has yet been shown to be capable of reaching and killing these deeply buried heads. The only visible damage done by these tapeworms is that caused by the heads setting up inflammation and killing the surrounding tissues to which they are attached.

Prevention.—To prevent the spread of tapeworm disease, the droppings of the fowls should be disposed of in such a way that the known intermediate hosts of the parasite, such as beetles, ants, flies, slugs, snails, and earthworms, are kept from eating the eggs or segments of tapeworms passed in the droppings of infested fowls; and poultry should be prevented from eating these intermediate hosts which may be carrying larval stages of tapeworms. Prompt removal of droppings, keeping the yards and houses free of trash, boards, boxes, and other unnecessary objects, and the filling in or liming of damp places near feed and water vessels, which places may serve as hiding or breeding places for the intermediate hosts, are valuable preventive measures. The plowing up of pens and seeding them to short-growing vegetation, rather than leaving them in a weedy, fallow condition, helps to reduce the number of ground beetles.

In some places poultrymen have resorted to raising chickens in confinement, under screen, and on raised floors, in order to prevent their becoming infested with tapeworms. Certain of the beetles, however, which are known to serve as intermediate hosts, are considerably smaller even than houseflies, so that the mesh of the screening must be fine enough to keep out such small insects, to be thoroughly satisfactory.

In order that poultry droppings may not be wasted but may be used for manure, without danger of spreading worm infection, it is recommended that the droppings be stored for awhile, as previously described.

Roundworms

EYE WORM OF POULTRY

The parasite (*Oxyuris mansoni*), known as Manson's eye worm, is known to have been present in Florida for many years and has spread to Louisiana. It occurs in chickens, turkeys, and peafowls, and can develop in various wild birds. The parasite is found under the nictitating membrane—that is, the transparent membrane which passes over the eyeball of the fowl in the act of winking. The worms are slender and colorless and are about three-fourths of an inch long; they can often be detected by a firm pressing of the tear sac at the inner corner of the eye, when they will wiggle out over the eyeball.

Symptoms and damage produced by parasite.—Affected fowls wink the eye continuously and frequently attempt to rub the head on the feathers of the wing, or to scratch at the eye with the foot. The

eyesight is not good. There is puffiness around the eye and a discharge from the eye and from the opening of the nostril. There is often a severe inflammation which may result in blindness; at times the entire eyeball is destroyed.

Life history of parasite.—This roundworm has an indirect life history, and its intermediate host has been shown by workers of the Florida Agricultural Experiment Station and elsewhere to be a cockroach (*Pycnoscelus surinamensis*). The cockroaches are found beneath boards and trash and in the vegetation at the edges of the fences; they feed on whatever food material is present, including the droppings of the fowls. From the droppings the cockroaches obtain the eggs or newly hatched larvae of the round worms, the eggs having been washed down the tear ducts from the eye of the fowl and having then been swallowed and passed in the droppings. The young roundworm develops in the body of the cockroach and when the roach is eaten by a fowl the worm is freed in the bird's crop. It passes up the esophagus to the mouth and then through the tear ducts to the eye.

The cockroach which spreads the parasite in this manner in Florida and Louisiana also occurs in Texas, and in certain places in the North it has been found in greenhouses. There is danger, therefore, that the eye worm may spread to States other than Florida and Louisiana. By the feeding of cockroaches containing the young stages of the worms, the eye worm has been experimentally developed in ducks, bobolinks, a blackbird, a pigeon, a loggerhead shrike, and a blue jay; such birds as these must, therefore, be considered possible carriers of the roundworm in areas in which it is found in poultry.

Prevention.—The removal from the chicken yard and houses, and from the area around the yards, of all trash, boards, boxes, and other unnecessary objects, which may serve as hiding places of cockroaches, is probably the most important control measure. Roaches, which come from the outside into a clean yard, free from objects which may serve as hiding places for them, are likely to be eaten promptly by the chickens before the roaches have a chance to become infected by eating the chicken droppings. Such uninfected roaches will not cause worm infestation. Hiding places enable the roaches to become infested and to infect the chicken which subsequently captures them. The daily collection of droppings and their removal to a place where cockroaches cannot get at them is a measure of value. Affected birds should either be treated and cured or killed and destroyed.

GAPEWORMS ¹¹

A roundworm that produces unmistakable symptoms of disease is the gapeworm (*Syngamus trachea*). This parasite occurs in turkeys, chickens, pheasants, and guinea fowls. Chickens rarely become infected with gapeworms after they are 8 to 10 weeks of age, but turkeys and guinea fowls are susceptible throughout life. Chickens that become infested with gapeworms when very young may, in the absence of reinfection, retain the infestation for 4 to 5 months. As a rule, however, the worms are lost within a few weeks. Guinea fowls are susceptible to gapeworm infestation at any time during their life but usually lose their infestations in 3 to 4 months. In the absence

¹¹ For additional information on gapeworms see Leaflet 207, Controlling Gapeworms in Poultry.

of reinfection, turkeys may carry gapeworms for as long as 7 to 8 months and are probably one of the chief factors in the spread of gapeworm disease to chicks. Young poults as well as chicks may suffer severely from gapeworm infestation. The death rate among poults and chicks from gapeworm infestation is usually high.

Gapeworms are attached to the wall of the windpipe or trachea, on its inner surface (fig. 25). The male and female worms are joined together so that the two worms form a Y.

Symptoms of damage produced by parasite.—The worms clog the windpipe of infested birds, and because of an insufficient supply of air, young chicks and poults that have gapeworms in their windpipes will open their beaks and gape (fig. 26); this behavior has given rise to the name “gapes,” as applied to the disease. There is often a convulsive shaking of the head, with a hissing cough. This continuous effort to obtain air prevents the infested birds from feeding; this and also the fact that the worms are bloodsuckers weaken the chickens so that they become thin and pale. Death may result from suffocation or from general weakness.

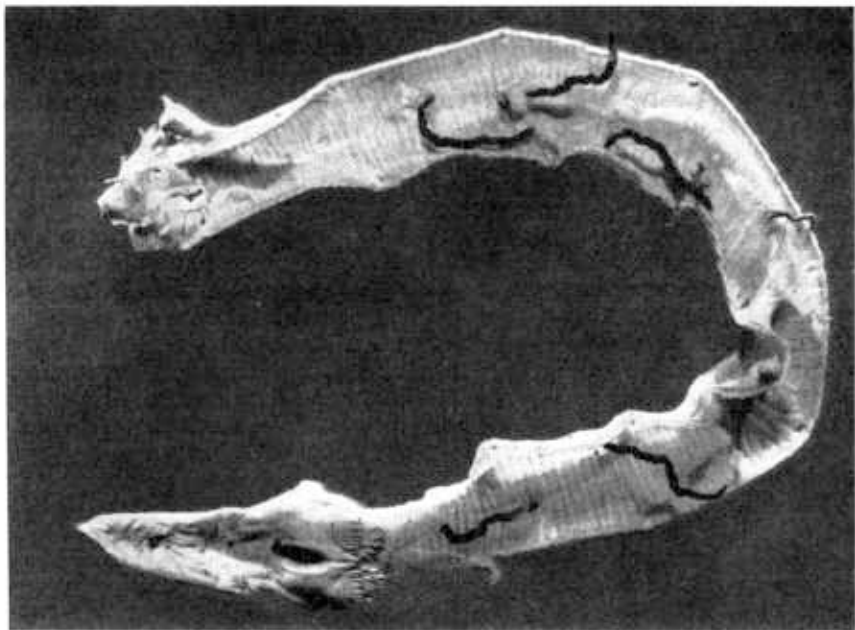
Life history of the parasite.—This parasite has a direct life history. Eggs of the parasite are coughed up from the windpipe and swallowed by the chicken or turkey which harbors the worms. These eggs pass out in the droppings, develop, and some of them hatch. Either the infective eggs or the young roundworms which hatch from them may then be swallowed by fowls in the act of feeding or drinking. Within a week the young worms will have reached the lungs, and from there they work their way up into the windpipe and may be fully developed within another week or 10 days.

Earthworms may play an important part in the spread of gapes. The infective eggs or the young gapeworms which have hatched in the soil from the eggs in the fowls' droppings may be eaten by earthworms; they burrow into the body muscles of the earthworm and may remain alive for considerable periods. The earthworm in these cases is not a necessary intermediate host of the parasite; it is merely a mechanical carrier or reservoir, protecting the young gapeworms from conditions such as drought and high and low temperatures, conditions which would otherwise kill the young parasites. Earthworms may thus carry the young gapeworms over from one warm season to another.

Another important factor in the spread of gapes is the fact that turkeys and guinea fowls may carry gapeworms throughout their whole life and thus may serve as sources of infection for chicks and young turkeys.

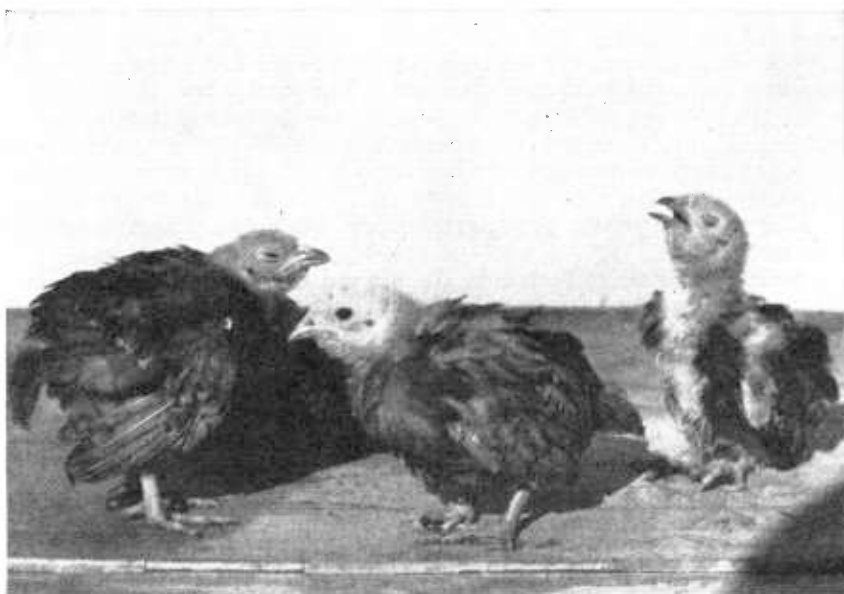
Prevention.—Raising young turkeys and chicks entirely separate from older turkeys and guinea fowls and on areas not recently used by turkeys is the most important preventive measure. If gapeworm disease has been present in the vicinity, dry, sandy soil should be selected for young turkeys and chicks to run on, as such soil is unfavorable to earthworms and for the development of gapeworm eggs and larvae. Young turkeys and chicks should be shut up until the dew has dried off in the morning, when most of the earthworms that have come to the surface will have disappeared.

Treatment.—Various medicinal treatments have been advocated but none has proved as efficacious, in controlled tests, as barium an-



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FIGURE 25.—Gapeworms attached to windpipe of young turkey.

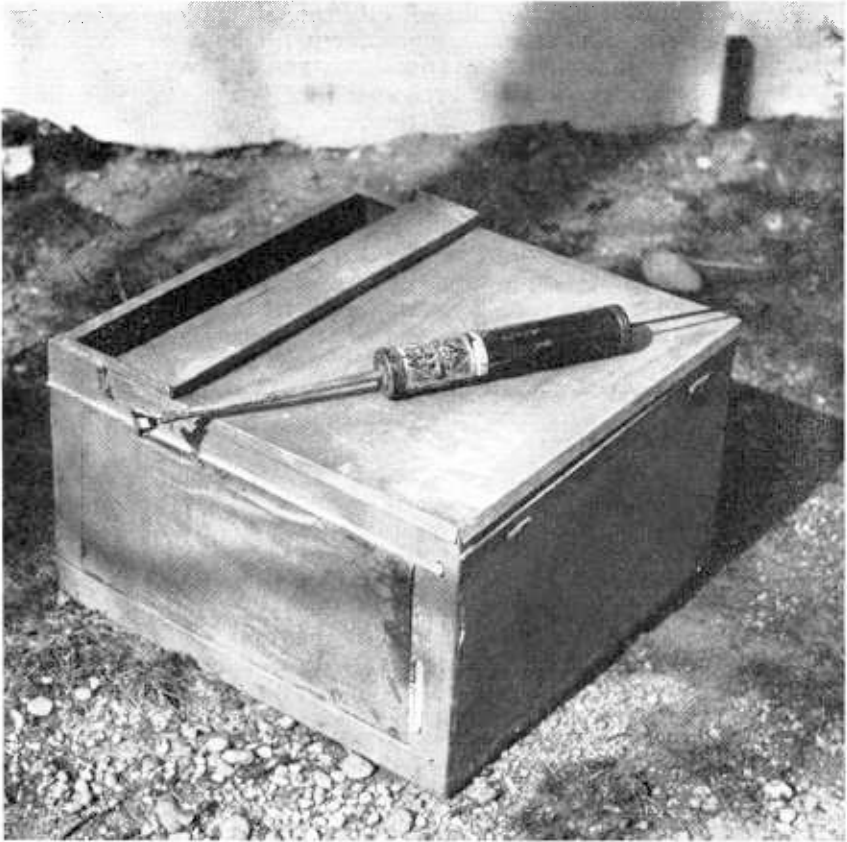


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FIGURE 26.—Chicks affected with gapeworms.

timonyl tartrate. Critical tests for this compound inhaled as a dust proved safe and efficacious for the removal of gapeworm from young chicks, turkey poults and adult turkeys. However, if taken internally, the powder is poisonous.

For treatment, the infected birds are placed in a closed container or box and exposed to the powder for 15 to 20 minutes. It is important that the powder be dispersed into the treatment box as a very fine



71090-B

FIGURE 27.—Dust gun and box used for treating young chickens for gapeworms.

dust, with the nozzle of the gun pointing away, preferably upwards, from the birds. A dust gun with the lip turned up is an ideal type to use for the dispersion of the powder (fig. 27). The size of the dose is determined by the cubic capacity of the container. One ounce or less of barium antimonyl tartrate is sufficient for a box having a capacity of 8 cubic feet. The box should be deep enough to allow a space of at least 12 inches above the heads of the birds when standing erect. In the beginning, one-third of the total dose is blown into the box by means of a dust gun through an opening at the top. The box, if of a convenient size, is then tilted slowly from one side to the other several times. Tilting causes the birds to stir around in the box,

thereby aiding in redispersing any powder that may have settled on the feathers or the floor of the box, and forcing the birds to breathe more heavily and more frequently. This affords a better opportunity for the powder to reach the worms that may be located in the lower part of the windpipe. In the case of mature birds, when the treatment box is likely to be too heavy to tilt, a small electric fan may be placed on the floor of the box to keep the powder agitated. Five minutes after the introduction of the first one-third of the powder, the second one-third is introduced, and the tilting or the use of the fan is repeated. The remaining powder is introduced 10 to 15 minutes after the beginning of the treatment, and the box is again tilted or the fan used. The birds are released 5 to 10 minutes after the last of the powder has been blown into the box.

Mechanical removal, although a slow, difficult, and rather dangerous procedure, may be accomplished by the insertion of a loop of horsehair down the windpipe and the rotation of the loop in such manner as to dislodge the worms from the wall and entangle them in the hair, which is then withdrawn. A small quill feather, which is stripped of all its web except a small tuft at the end, may also be used in place of the hair; a little kerosene or oil of turpentine put on the feather will aid in loosening the worms and later will cause the bird to sneeze or cough and thus help to bring up the worms. Wire extractors made by commercial firms are used in the same manner.

CROP WORMS

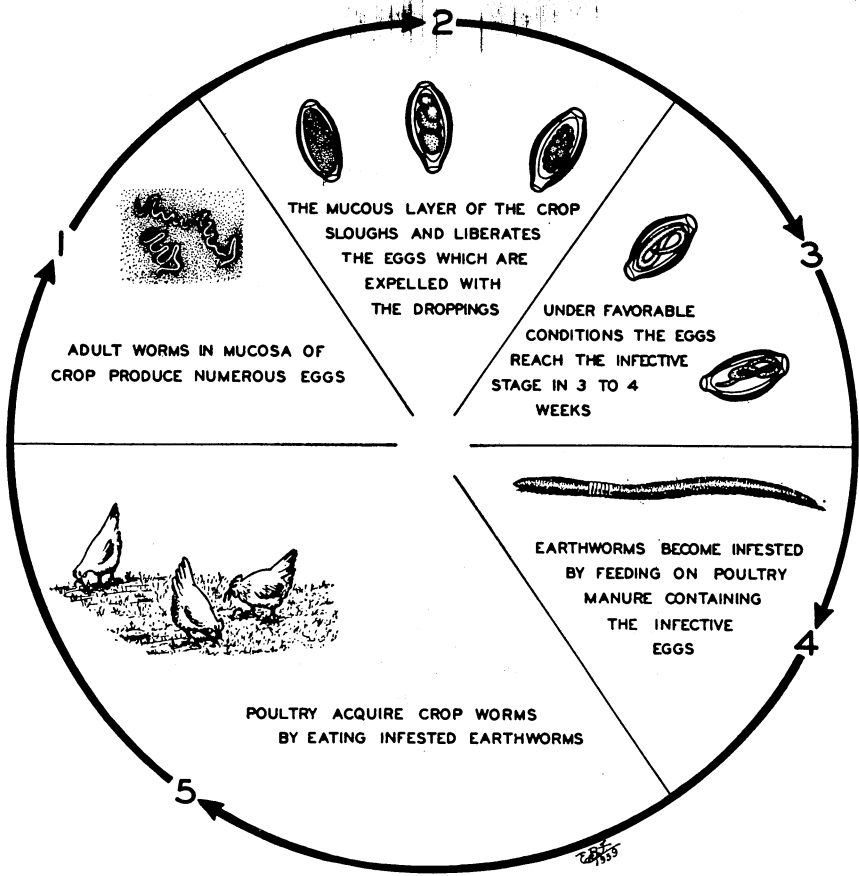
Roundworms may occur in the crop and occasionally also in the undilated esophagus of chickens and turkeys. They are sewed into the walls and have the appearance of a wavy, white thread. The worms move around inside the wall and form burrows or tunnels.

One of these roundworms (*Gongylonema ingluvicola*) is comparatively rare, and is not known to injure the health of the fowl aside from slight local damage to the wall of the crop. This roundworm has an indirect life history; there is evidence that cockroaches and dung beetles may be the intermediate hosts.

Another crop worm (*Capillaria annulata*) (fig. 28) appears to be of much more common occurrence. In severe cases these roundworms may be present in large numbers and may greatly damage the walls of the crop and the undilated esophagus (fig. 29). They interfere with digestion, and the fowls become progressively weaker and finally may die from the effects of the parasite. Earthworms serve as the intermediate host of this crop worm. On the other hand, in the case of a closely related species (*C. contorta*) which occurs in domestic ducks in Europe and in turkeys, gallinaceous game birds, and wild ducks in the United States, direct experimental transmission from one bird to another has been accomplished. The eggs which pass out in the droppings develop to a stage which will infect the fowl swallowing them in contaminated feed or water.

Prevention.—General sanitary measures such as described on page 49 are advised.

Treatment.—No medicinal treatment has yet been developed. Worms which have burrowed into the crop are more or less protected from the action of drugs.



2501-7

FIGURE 28.—Life history of the poultry crop worm, *Capillaria annulata*.

STOMACH WORMS

In the two stomachs of domestic birds, that is, in the proventriculus or glandular stomach and in the gizzard or muscular stomach, several different kinds of roundworms may be found.

The Tetramere of Chickens

The parasite (*Tetrameres americana*) shows very striking differences from most other roundworms. The usual slender, elongated form of roundworms is lost in the case of the female tetramere (fig. 30). While young, these parasites enter the glands of the stomach and as they develop to adults the large number of eggs which form within the body causes it to swell until it is practically globular in shape; also, its color changes to bright red. These parasites may be present in adult fowls without any apparent injury to the health of the fowl. In young chicks, however, they interfere with the proper digestion of food, so that general weakness and diarrhea, and even death, may result.

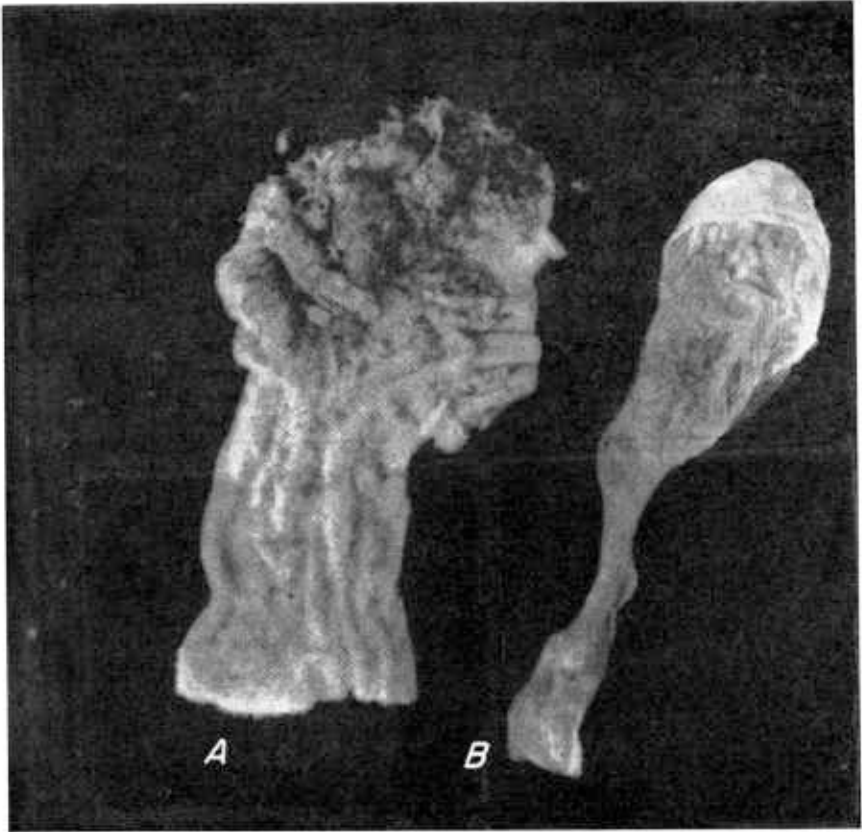


FIGURE 29.—A, A crop heavily parasitized by the crop worm (*Capillaria annulata*) ; B, a normal crop. Note on the extreme left the threadlike worms which caused the injury.

Life history.—The tetramere has an indirect life history and the intermediate hosts have been found to be grasshoppers and cockroaches.

Prevention.—Raising young chicks in such a way that they cannot feed on grasshoppers or cockroaches which may have had access to the droppings of older, infected chickens, and disposing of droppings so that the worm eggs in them are destroyed or that insects cannot get at the droppings, are the most important preventive measures.

Treatment.—No medicinal treatment is known.

The Spiral Stomach Worm

A short white roundworm (*Dispharynx spiralis*) which is curved or even twisted in a spiral, is found occasionally in the glandular stomachs of chickens, turkeys, and pigeons, as well as in gallinaceous game birds, in this country, and if present in considerable numbers may seriously affect the health of the bird. The more evident symptoms are droopiness and loss of weight, in spite of the fact that the birds have a ravenous appetite even up to the time of death. In

pigeons the eye has been said to lose its color when the birds are suffering from the effects of this stomach worm. The stomach may be considerably enlarged and the glands of its walls may be partly or almost completely destroyed.

Life history.—This roundworm has an indirect life history, and sowbugs, or pillbugs, have been found to be the intermediate hosts.

Prevention.—Measures which will eradicate sowbugs from the premises, so that the birds cannot eat them, are of great importance. Keeping the birds in dry, light quarters and the removal of unnecessary objects under which the sowbugs may hide are of value in this connection. The proper disposal of droppings, either to destroy worm eggs or keep them from all intermediate hosts, is important.

Treatment.—No medicinal treatment is known.

Gizzard Worm of Chickens and Turkeys

A slender white gizzard worm (*Cheilospirura hamulosa*) about one-half to three-fourths of an inch long, has been the cause of deaths of chickens in this country, and has also been found in turkeys. It passes through the horny lining of the gizzard, leaving small, round holes with raw, raised edges, and burrows into the muscular wall, producing tunnels in the wall or causing the formation of wartlike growths on its surface. Eggs of the parasite pass out of the holes and mix with the gizzard contents, eventually being discharged by the bird in its droppings. The wall of the gizzard may be so badly damaged by these worms that the digestion of food is interfered with and the health of the fowl consequently suffers from it.



FIGURE 30.—A tetramere from the glandular stomach of a chicken. Enlarged about four times.

Life history.—This roundworm has an indirect life history and its intermediate hosts have been found to be grasshoppers, flour beetles, and sandhoppers.

Prevention.—Sanitary measures, such as frequent collection and proper disposal of droppings so that grasshoppers and other intermediate hosts may not feed on them and thus become infected with the early stages of the roundworm, and secondly, measures to prevent the fowls from eating grasshoppers, are advised. Confining fowls to runs which have been sown to a short, thick, green vegetation, such as grass, rather than allowing them to range in long, dry vegetation which is favorable to grasshoppers, helps to reduce the number of these insects eaten by the fowls.

Treatment.—No satisfactory treatment is known.

Gizzard Worm of Domestic Geese and Ducks

In domestic geese and ducks a small slender roundworm (*Amidostomum anseris*) sometimes reddish in color from blood which it has swallowed, may be found burrowing in the horny lining of the gizzard; it does not invade the wall to so great an extent as does the gizzard worm of chickens and turkeys but causes more damage to the surface. There is considerable loss of blood by the bird, and the gizzard lining shows roughened areas stained brown from blood. The parasite may produce poisons which also weaken the bird. Numerous deaths may

occur in flocks in which these parasites are present in large numbers.

Life history.—This roundworm has a direct life history. The eggs pass out in the droppings, young roundworms hatch from them, and, after being taken in by the birds in the act of eating or drinking, the worms develop to adults in the gizzard. This parasite has been transmitted experimentally from the domestic goose to the domestic duck in this manner.

Prevention.—Sanitary measures which prevent the contamination of feed and water with the droppings of infected fowls are of value.

Treatment.—No satisfactory treatment is known.

INTESTINAL ROUNDWORMS

Large Roundworm of the Intestine

The large roundworm or ascarid (*Ascaridia galli*), found commonly in chickens and less commonly in domestic ducks, geese, and turkeys,



FIGURE 31.—Roundworms (*Ascaridia galli*) from the small intestine of a chicken. (Courtesy J. E. Ackert.)

occurs in the small intestine and attains a length of from 1 to 4½ inches when fully grown (fig. 31). These worms may be present in such numbers as to block the intestines. Large numbers of the young worms may kill chicks in from 10 to 12 days. The parasites stunt the growth of the chick and prevent proper bone development, so that weakness results (fig. 32). Young chicks are most seriously affected by this roundworm. If the chick does not become infected until after it is 3 months old, the parasites do less damage to it. Grown fowls which harbor this parasite may be unthrifty and their egg production low. The adult worms occasionally wander up the oviduct and are trapped in the hen's egg as it forms.

Life history.—The life history of this parasite is direct (fig. 33). The eggs of the parasite pass out onto the soil in the droppings of the fowl and the young stage of the worm develops within them in a period of about 15 to 20 days under favorable conditions. The young worm hatches from the egg when the latter is swallowed by a fowl. The young worms may burrow into the inner surface of the wall of the intestine, causing damage to the glands, for a period extending from about the tenth to the twentieth day after the egg is swallowed. Then the worms return to the interior of the intestine to develop into adults in about 2 months.

The eggs of the parasite are thick-shelled; they are resistant to cold but more easily killed by heat. In Kansas, the high temperature of summer has been found to kill all the eggs of this parasite on the surface of the soil and to a depth of 6 inches in unshaded places, but in shaded spots the eggs survived.

Prevention.—General sanitary measures should be adopted to prevent the worm eggs from developing in the soil and later being swallowed by the fowls. Rotation of runs has been found valuable. Special protection of chicks until they are 3 months of age, by raising them away from older chickens or areas ranged by such chickens, will prevent the greatest injury. A nutritious diet, rich in vitamins, has been found to be helpful in building up the resistance of the chick to this parasite.

Treatment.—One of the quickest and most effective treatments for the removal of the large roundworm consists in the individual dosing of each bird with carbon tetrachloride or the closely related drug, tetrachlorethylene, using a 1-cubic centimeter dose for adult birds; for young chickens, however, the dose must be reduced and given with caution. From evidence available, it is safe to treat young chickens at 2 months of age with tetrachlorethylene, which is the safer of the two drugs. The drug is most easily given in gelatin capsules, although it may be introduced directly into the crop through a soft rubber tube passed down the esophagus. Care must be taken that the drug does not get into the lungs, as in that case it may be quickly fatal.

A number of mixtures containing nicotine sulfate and a special fuller's earth known as Lloyd's alkaloidal reagent have been tested by workers of the California Agricultural Experiment Station. The treatment which proved to be the most satisfactory consists in the administration, to each bird, of a No. 2 capsule containing 0.35 to 0.4 gram of a mixture of 7.92 grams of 40-percent nicotine solution and 16 grams of Lloyd's alkaloidal reagent, which is a selected fuller's earth.

For mass treatment, rather than individual treatment, the California Agricultural Experiment Station recommends the following:

Add to the mash 2 percent by weight of tobacco dust containing at least 1.5 percent of nicotine, and feed this mixture to the flock for

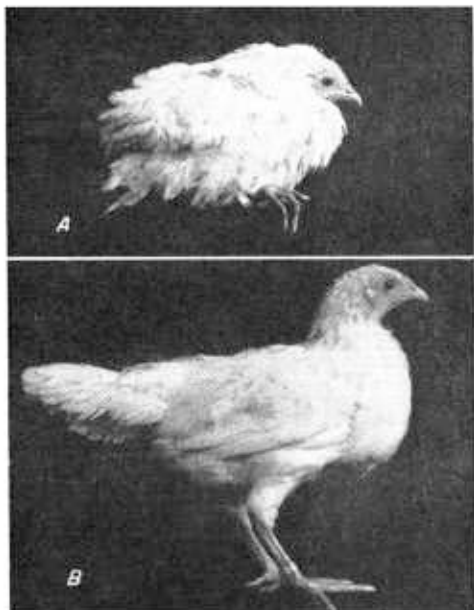
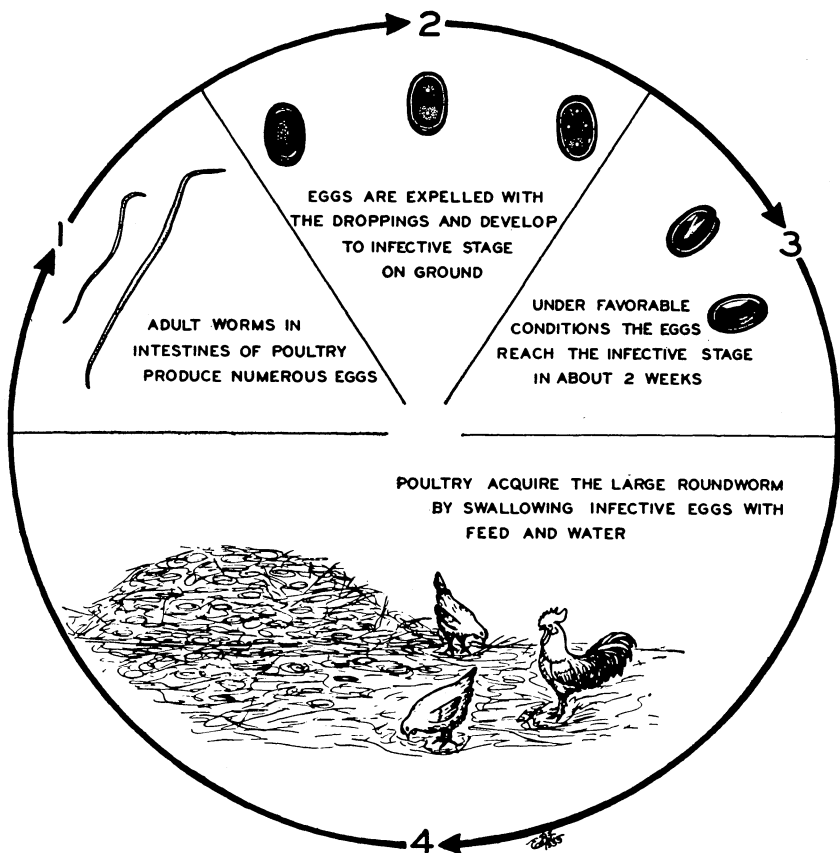


FIGURE 32.—A, Chicken suffering from large roundworms of the intestines, unable to recover from parasitism; B, control from same hatch, aged nearly 4 months. (After Ackert and Herrick.)

a period of 3 or 4 weeks. Treatment may be repeated at 3-week intervals as often as necessary.

Investigators in the Bureau of Animal Industry have demonstrated that the feeding of a medicated mash containing 15 grams (1 teaspoonful) of a 40-percent solution of nicotine sulfate, 151 grams of phenothiazine, 278 grams of bentonite, and 44 pounds of dry mash,



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FIGURE 33.—Life history of poultry roundworm, *Ascaridia galli*.

maintained a low level of parasitism on worm-infested soil. The bentonite is an inert claylike material which serves as a carrier for the nicotine. Uncombined nicotine is toxic to birds in therapeutic doses. For treatment of range birds, this medicated mash is fed to infested birds for 3 days in succession and at intervals of 3 weeks during the warmer months.

If a single-dose treatment is desired for the removal of the large roundworm, the California station recommends the use of one teaspoon of oil of chenopodium, thoroughly mixed with a moist mash, for each lot of 12 birds.

Large Roundworm of Pigeons

In the intestines of pigeons may be found a large roundworm which closely resembles that found in chickens, but it is a different species (*Ascaridia columbae*). This parasite may be present in large numbers, as many as 500 having been collected from 1 pigeon. The worms are sometimes found to have wandered into the stomachs and even up into the esophagus. The life history is similar to that of the large roundworm of chickens (fig. 29), and preventive measures would be similar in the two cases, with modifications to meet the different conditions under which pigeons are raised.

Treatment.—Carbon tetrachloride in repeated doses of from 1 to 2 cubic centimeters, given in liquid cereal or in liquid paraffin, has been reported to be satisfactory for the removal of this parasite. The pigeons may occasionally regurgitate the drug.

Common Cecum Worm, or Heterakid, of Poultry

The common cecum worm of poultry is also known as the heterakid (*Heterakis gallinae*); it occurs in the ceca, or blind guts, of chickens, turkeys, guinea fowls, and domestic ducks and geese. This worm attains a length of from three-tenths to one-half inch. The worms are sometimes present in enormous numbers and may cause a serious inflammation of the ceca, especially in young chicks. As already noted, they are apparently involved in the transmission of blackhead in the presence of infective blackhead material.

Life history.—The life history of the roundworm is direct, the eggs developing in the soil in a period of from 7 to 12 days under favorable conditions. They are very resistant to freezing and to drying. The young worm hatches from the egg when it is swallowed by a fowl. The young worms invade the wall of the ceca for a short period, and may do considerable damage at this stage; later they return to the interior of the ceca and develop to adults in about 24 days after entering the fowl's body.

Earthworms may be a factor in spreading cecum worms and other worms; the eggs of the roundworms may be eaten by the earthworms and later reach fowls by being passed in the casts of the earthworms and thus infecting otherwise uninfected soil, or by the earthworms being eaten by the fowls.

Prevention.—As in the case of the large roundworm, general sanitary measures, rotation of yards, and special protection of young chicks are of value in preventing infestations with this parasite.

Treatment.—With the introduction of phenothiazine a few years ago, the removal of cecal worms by means of drugs has become more effective. Investigations at the State College of Washington indicated that phenothiazine was effective in removing cecal worms. Since then the efficacy of this drug for the removal of the cecal worm has been demonstrated many times.

Under experimental conditions, phenothiazine will remove 95 to 100 percent of the mature or nearly mature cecal worms from naturally infested chickens. When it is given either in single doses of 0.5 grams per bird in gelatine capsule or in ground feed excellent results are obtained. Under ordinary conditions the feeding of a mash containing 15 grams of a 40-percent solution of nicotine sulfate (1 teaspoonful), 151 grams of phenothiazine, and 287 grams of bentonite, maintained

a low level of parasitism in the treated birds. This mixture contained 44 pounds of dry mash and was fed for three successive days at 3-week intervals. The mixture is effective also for the removal of the large roundworm of chickens (see p. 79).

No significant toxic manifestations following the administration of this drug to chickens have been reported. As much as 25 grams have been given in one dose without harmful results.

Another treatment consists in the use of rectal injections of oil of chenopodium in a bland oil, such as cottonseed oil. The dose is 0.1 cubic centimeter of oil of chenopodium in 5 cubic centimeters of cottonseed oil for a bird weighing $11\frac{1}{2}$ pounds. Probably double this dose would be effective for a bird weighing 3 pounds or more. This mixture may be made up at the rate of one teaspoon of oil of chenopodium in 6 fluid ounces of cottonseed oil and given at the rate of one-third of an ounce to birds weighing 3 pounds or more, a proportionately smaller dose being used for smaller birds. The two ingredients should be thoroughly mixed and given with a hard-rubber enema syringe. It is as easy to give this treatment by rectum as it is to give a treatment by mouth. The tip of the syringe should be inserted into the rectum and the mixture injected slowly.

Single doses of drugs by mouth are relatively ineffective. The drugs commonly fail to enter the ceca, and the occasional entry is too uncertain to make these treatments reliable.

Intestinal Strongyle of Pigeons

In pigeons a serious disease may be caused by the delicate, slender roundworm known as the pigeon strongyle (*Ornithostrongylus quad-riradiatus*). This parasite occurs in the small intestines of pigeons and some wild birds, chiefly the mourning dove. Birds heavily infested with this parasite become droopy, the feathers are ruffled, and the neck is retracted. The birds remain squatted on the ground and seldom move; when disturbed, they attempt to move but frequently tip forward on the breast and head. Food is taken sparingly and is frequently regurgitated, along with bile-stained fluid. Infested birds drink an excessive amount of water. There is a pronounced greenish diarrhea, and the birds lose weight rapidly. Death is preceded by prostration and difficult, rapid breathing.

Life history of the parasite.—The life history of this worm is direct. The eggs of the parasite pass outside with the droppings and, under favorable climatic conditions, hatch within 19 hours. Three days more are required for the larvae to reach the infective stage. When the infective larvae are swallowed by a pigeon or other susceptible host, they mature in the small intestine, and the females begin to deposit eggs in 5 or 6 days. The intestines of fatally infested birds are markedly hemorrhagic and have a green mucoid content, with masses of sloughed epithelium.

Prevention.—Air drying and direct sunlight are destructive to the eggs and larvae of this parasite. Therefore, it is essential that pigeon lofts be located on soil which has good drainage and is exposed to the direct sunlight. Drinking troughs and baths should be exposed to the direct sun and so arranged that water will not be splashed into the pen.

Treatment.—A treatment which has been reported as effective in

expelling these worms consists in giving each pigeon three doses, each of which contains five centigrams (0.05 gram) of thymol. These doses should be given on alternate days and the third dose followed by a 1-cubic centimeter capsule of castor oil.

Pigeon Capillariid

The threadworm (*Capillaria columbae*) occurs in the small intestines of pigeons and chickens and also occasionally in turkeys. The worms are slender and colorless, usually about one-half inch long, and very difficult to see unless present in large numbers. Heavily infested birds lose weight, become emaciated, and sometimes die. In fatal cases and in severe advanced cases of infestation the intestines show extensive destruction of the mucosa, frequently with complete sloughing of the mucous membrane.

Life history of the parasite.—The life history of this parasite is direct. The eggs pass out in the feces. Under favorable conditions, young worms develop within the eggs in about a week. These eggs are now infective to other birds. The young worms escape from the eggs only after being ingested by a susceptible host. In the small intestine the young worms penetrate rather deeply into the intestinal mucosa and remain there until nearly mature, when they migrate to a position nearer the lumen of the intestine.

Prevention.—Prevention consists in giving the proper attention to general sanitation and the selection of well-drained areas for permanent pens and lofts.

Treatment.—There is at present no satisfactory treatment for the removal of these worms.

Other Roundworms of the Intestines

There are several different species of hairworms, or capillarids (*Capillaria* spp., in addition to *Capillaria columbae*), which occur in the small intestine and ceca of domestic poultry, all kinds of domestic birds being known to harbor such worms at times. The worms are very slender and colorless, usually from one-half to three-fourths of an inch long, and are found with difficulty unless present in large numbers. They may seriously affect the health of the fowls. Carbon tetrachloride given in a 1-cubic centimeter dose, and repeated about 7 days later, has been effective in removing some kinds of capillarids. The life history, so far as known, is direct, and general sanitary measures should be adopted to prevent reinfestation.

In chickens an extremely small roundworm, the chicken strongyloides (*Strongyloides avium*) has been found in the ceca; in young chicks especially, it may seriously affect the health. The walls of the ceca may be greatly thickened, and a bloody diarrhea may be present. If the chicks survive this acute stage, they may show no bad effects from the parasite, even though it is present, when the chickens are fully grown. The life history of this parasite is direct, but, unlike the direct life histories of other roundworms of poultry, this one includes stages in which the worms develop in the soil to adult males and females, which give rise to young. No treatment has yet been developed for removing this parasite. Special protection of young chicks and general sanitary measures are of value in preventing the spread of the parasite.

LICE

There are at least seven different species of lice occurring on domestic chickens, while still other forms occur on turkeys, ducks, and guinea fowls. As different species of lice are usually confined to different parts of the body and feathers, they are commonly referred to as head lice, wing lice, body lice, shaft lice, and fluff lice, although the distinction is not very exact, since the various species intermingle to some extent.

Lice on Chickens

The two most important lice on chickens are the head louse (*Lipeurus heterographus*), and the body louse (*Eomenacanthus stramineus*). The head louse (fig. 34) is most injurious to young chicks. It occurs on the head at the base of the feathers or the down; it passes readily from one chicken to another, and from the hen to her chicks. It is important to treat the hen for lice before the hatch comes off. Treatment, as given below, should be applied to the head. The body louse is most injurious to grown fowls but occasionally affects young chicks. It causes irritation to the skin, with at times the formation of scabs or blood clots. It is found directly on the skin, the most favored site being just below the vent, but head, neck, legs, and body may show the presence of these lice.

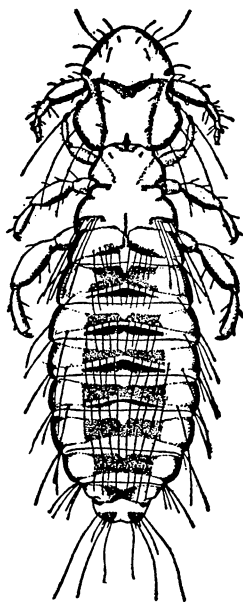


FIGURE 34.—The head louse, male, top view. Greatly enlarged.

The shaft louse, the wing louse, and three other less common species are not so serious a menace to chickens.

Lice on Turkeys

Four species of lice are found on turkeys; two of these are species which also occur on chickens, whereas the other two are restricted to the turkey. The common body louse of chickens may cause considerable irritation to both young and grown turkeys; the shaft louse of chickens may be present, without evident bad effect. The two species which are found on turkeys only, the large louse (*Gonides meleagridis*) and the slender turkey louse (*Lipeurus gallipavonis*) may be markedly injurious to poults and may cause severe annoyance to adult birds.

Lice on Ducks and Geese

Young ducks which are hatched by hens may suffer from the head louse of chickens. There are also at least three species of lice which are restricted to ducks and geese, but they are seldom present in sufficient numbers to cause noticeable annoyance.

Lice on Pigeons

There are two species of lice, different from those found on other domestic birds, which cause considerable annoyance both to old birds and to partially feathered squabs.

Methods of Controlling Lice

The problem of the control of poultry lice primarily involves the destruction of the parasites on the birds themselves. Poultry lice live continuously and breed on the plumage and bodies of their hosts. Means of control should therefore be directed primarily toward the individual birds and secondarily to the house and litter.

Birds should be deloused as often as they become infested. It is important to realize that reinfestation will take place upon hatching of the eggs of the parasite. Repeated treatments should take into consideration natural reinfestation. It is advisable to see that poultry are free of lice before the advent of cold weather. It is in the fall that surplus stock is usually disposed of and fewer birds will need to be treated. Moreover, the birds should enter the winter in the best of health. Any birds that are to be added to the flock should be isolated and treated until free of lice.

SODIUM FLUORIDE

Sodium fluoride may be used as a dip or as a powder for the eradication of poultry lice or infested birds. To rid the birds of these parasites and their eggs, it is necessary to treat only once, provided a thorough job is done.

The commercial grade of sodium fluoride is recommended for this purpose because it is generally available and also cheaper than the technical grade. Sodium fluoride is a white powder and is poisonous to human beings and animals when taken internally. Therefore it should be used with caution and the container properly labelled before storing, so that it will not be mistaken for something else. Solutions of this drug should be disposed of in such manner that they will not be accessible to animals and human beings.

Since lice are found on various parts of the body, it is essential that the dust or powder be placed on areas commonly visited by them. The dust may be applied with a shaker can (any can with perforated lid will do) but this method usually requires the services of two people, one to apply the powder and the other to hold the bird. One hand is used to shake the powder from the can and the other to raise the feathers so that the powder may be applied next to the skin. There is considerable wastage of powder with this method of dusting and some receptacle should be placed underneath the bird to catch the surplus powder. The mixing of 2 parts of flour of sulfur and 1 part of sodium fluoride is sometimes advisable for economy.

The so-called pinch method involves the placing of a small pinch (an amount conveniently held between the index finger and thumb) of powder next to the skin in 11 places over the body; 2 along the back, 1 on the neck, 1 on the head, 1 on the breast, 1 below the vent, 1 on each thigh, 1 on the tail, and 1 on each wing when spread. One pound of sodium fluoride applied by the pinch method will treat about 100 hens.

Since sodium fluoride is irritating to the nose and throat, the operator should wear a respirator or a piece of wet cloth over his nose and mouth.

To avoid injury to the young chicks, it is always advisable to delouse hens before the chicks are hatched.

Because of their large size, grown turkeys should receive about 15 pinches of the powder. Pigeons need not receive more than 5 pinches.

When a large number of birds are to be treated, experience has shown that dipping in sodium fluoride solution is economical, convenient, and effective, and is devoid of any harmful effects. It is essential that dipping be carried out on a mild sunny day or in a warm house and that the operation be completed long enough before sundown to allow the birds to become thoroughly dry before roosting time.

The solution is prepared by adding 1 ounce (a rounded tablespoonful) of sodium fluoride to each gallon of tepid water measured in a tub. One ounce of near-neutral soap per gallon of dip is said to increase its efficacy. The tub should be placed on a box at a convenient height for dipping. The birds are held in one hand by the wings and plunged into the solution. The head should not be submerged. With the other hand, the feathers beneath the solution are raised to allow the skin to become uniformly wet; then the head is submerged once or twice before the bird is held up to drain for a few seconds before being released. The actual dipping of a fowl requires about 20 to 30 seconds.

To completely rid pigeons of lice, it is necessary to add 1 ounce of laundry soap to the dip to obtain a complete wetting of the feathers.

BENZENE HEXACHLORIDE

Numerous experiments with benzene hexachloride (commonly called BHC) for the control of poultry lice, have shown this insecticide to be very satisfactory. It is very effective against all motile lice and possesses the added advantage of being able to destroy the eggs. Benzene hexachloride is manufactured in several forms, one of which, the wettable 50-percent product, containing from 5 to 6 percent gamma isomer, appears suitable for use as a poultry lousicide. Wettable 50-percent benzene hexachloride can be used as a fumigant, as a dip, and as a dust.

Benzene hexachloride, as a fumigant, is effective against body lice, but somewhat less effective against head lice. A convenient, as well as an effective method of using this chemical as a fumigant is in the form of a roost paint. A good roost paint made from a 50-percent wettable powder can be prepared by mixing 1.5 pounds of the powder in a gallon of water. The resulting suspension will then be approximately a 20-percent suspension containing approximately 1 percent gamma isomer. The gamma isomer is the actual killing agent present in the completed product. The suspension is applied to the roosts with a 4-inch paint brush. All roosts, perches, beams, rafters, and poultry-house equipment should be thoroughly painted. In fact, everything the chickens are likely to use as a perch should be treated. It is advisable to treat the poultry house shortly before the flock goes to roost. Thus, a longer and more intense exposure to the fumes is provided. One pint of the mixture will cover 200 feet of 2-inch roosts.

The wettable benzene hexachloride powder at present appears to hold considerable promise as a poultry lousicide, when used as a dust and as a dip. As yet, insufficient experiments have been conducted on poultry, using the wettable form of this chemical as a dip or dust to recommend it for general use. Some evidence has been presented which indicate that benzene hexachloride spray, dips, and fumigants may produce off flavors in both the eggs and the meat of poultry;

however, such evidence is not too convincing in the light of recent investigations.

OTHER TREATMENTS

Sodium fluosilicate may be substituted for sodium fluoride when used as a dip in the same way as the latter. Because of its coarseness, this material cannot be used very effectively as a dust.

DDT and derris powders are both capable of killing poultry lice. They can be used as a dust or as a dip. For dusting purposes, a 10-percent DDT powder applied to individual birds with a shaker can will destroy poultry lice, but will not prevent reinfestation. About one-half ounce per bird is sufficient. When used as a dip, 50-percent wettable DDT powder lends itself admirably to this mode of treatment. One pound of powder suspended in 25 gallons of water will make a 0.25-percent DDT dip.

Derris powder containing 5 percent of rotenone has a high insecticidal value when used as a dust against poultry lice. The powder should be mixed with inert diluents such as pyrophyllite, tripoli earth, pumice, or powdered sulfur in the proper proportions to make a 1-percent rotenone mixture. Thus, 1 pound of derris powder containing 5 percent rotenone mixed with 4 pounds of inert dust will make a mixture containing 1 percent of rotenone. Both DDT and derris powder can be applied with a shaker can.

Dust baths containing a mixture of tobacco dust, DDT, derris powder, or other insecticides mixed with ordinary road dust are often recommended to destroy lice. While it is a good plan to let the birds dust themselves when they wish, no method which allows the bird to treat itself can be expected to eradicate all lice, since fowls cannot get the dusting powder on all parts of the body where lice are, and many lousy birds will not use the dust baths.

A number of other materials and mixtures have been tested and reported to be effective in the destruction of poultry lice. A 10-percent formulation of Lethane A-70, undiluted NH Dust, 2- and 10-percent tetramethyl thirouram salts, 30-percent cryolite, and other are reported as giving complete or nearly complete control. Combinations of DDT and Lethane A-70 are reported to result in complete destruction of both lice and mites.

DDT and benzene hexachloride are both lethal to the poultry tick. Dips containing 0.5 percent of DDT or 0.25 percent of benzene hexachloride will kill seed ticks. The seed ticks are the immature stages of this parasite and spend from 3 to 10 days on the body of the host. When poultry are infested with these small larval ticks, they can be dipped and the ticks destroyed. However, the problems in eradicating ticks from a poultry flock is largely one of destroying the adult forms. Experiments with both DDT and benzene hexachloride used as sprays in poultry houses, both as emulsions and suspensions of different percentages, have failed to eradicate this parasite. Those ticks that come in contact with the insecticide were destroyed, but due to their habits of living in deep cracks and crevices many are not reached by the treatment, and eradication by single treatment, therefore, is not usually achieved. Repeated spraying with 2-percent benzene hexachloride or 5-percent DDT, wettable products, will help to control this parasite.

Benzene hexachloride leaves an undesirable musty odor when sprayed in a chicken house, which persists for several days. When chickens or their eggs remain in direct contact with this chemical, it is possible that an odor may be imparted to the flesh of the fowls and their eggs. It is advisable, therefore, to keep the flock out of the treated poultry house until the odor has been largely dissipated.

A simple procedure, which is effective in controlling lice but will not eradicate them, consists in the application of undiluted 40-percent solution of nicotine sulfate to the top surface of the roosts by means of a paint brush. This is done a short time (from 15 to 20 minutes) before the fowls go to roost. The fumes of the nicotine kill the lice during the first, second, and third nights after application. The head lice, naturally, are least affected. As some of the lice are not killed and the eggs are not destroyed, it is necessary to repeat the treatment frequently.

It is possible and practicable to keep a flock of poultry absolutely free from lice and mites, and this should be the aim of everyone who is endeavoring to establish a successful poultry flock.

A simple and inexpensive way of protecting chickens from the attacks of ticks and to facilitate treatment is to provide readily demountable roosts supported from the floor and not touching the walls. These should be painted occasionally with anthracene oil or petroleum. Nests should be located away from roosting places. If constructed of metal, the nests can be quickly rid of ticks from time to time by burning out the straw.

Metal houses have been found to be effective in dealing with the ticks, as even without special attention they remain practically tick-free, and if necessary they can be disinfected easily by a fire of straw, paper, or other light material, after the removal of the roosts. Metal houses, however, are usually more expensive than wooden ones and are hot in summer and cold in winter. If they are used in summer, the fowls should be provided with shade outside the house.

When ticks have once been eradicated from the premises no chickens should be added to the flock until they have been quarantined for 10 days in temporary coops. The coops should be destroyed after use or thoroughly treated with anthracene oil.

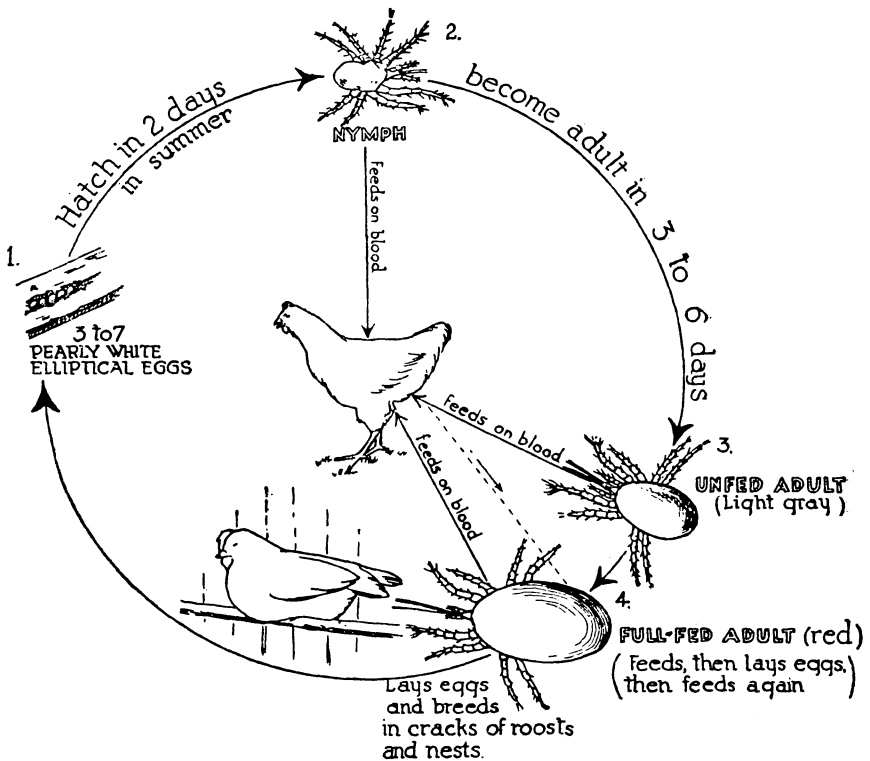
MITES

Common Red Mite

While there are many kinds of mites affecting poultry, there are three which are of special importance to poultry raisers, the best known being the common chicken mite or red mite (*Dermanyssus gallinae*). In the Northern States this mite is dormant in winter, except in chicken houses which are heated, but in the South it breeds and is active the year round, although it is always most abundant in summer. Unlike the other mites affecting poultry, this parasite, with few exceptions, is found on the birds only when it is feeding (fig. 35). It is nocturnal in habits, feeding at night and hiding during the day in the cracks of the roosts, in the nests, in the corners of the floor, or between boards. For this reason its presence often remains undetected until the chicken houses are badly infested and the poultry

raiser seeks an explanation for the drooping condition and listlessness of his fowls.

Treatment.—To eradicate the pest a thorough cleaning of the chicken houses and spraying with a suitable insecticide having sufficient body is all that is necessary. All roosts, loose boards, and boxes should be removed and the insecticide applied in the form of a rather coarse spray, using a suitable pump. One of the best substances for the purpose is one of the carbolineums. As this is a little too heavy to spray well, it may be thinned with an equal quantity of kerosene,



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FIGURE 35.—Diagram showing the life habits of the common chicken mite.

or the undiluted material may be applied with a brush to the roosts, roost supports, nest boxes, and other places where the mites are found. High-grade creosote also gives satisfactory results. Crude petroleum is somewhat less effective but is usually cheaper. It should be thinned by adding one part of kerosene to four parts of crude oil. Pure kerosene, kerosene emulsion, and carbolic acid, when brought in contact with the mites, will kill them, but as they all lack sufficient body for persistence the spraying must be repeated several times, making the use of these materials impracticable. The coal-tar dips, used in a slightly stronger solution than recommended on the labels, will be effective if the application is repeated, and the germicidal properties are a desirable feature. A single application of 10-percent "Lethane

A-70" plus dusting of the house and grounds underneath rids all birds of mites and considerably reduces the mite population in the house and on the ground. A 0.5-percent benzene hexachloride spray, prepared from 50-percent wettable benzene hexachloride powder, will considerably reduce the mite infestation. The spray is made by adding 2 pounds of the powder to 25 gallons of water. Best results are achieved by constantly agitating the mixture while spraying. Whatever preparation is used, the birds should be kept out of the houses until the fluid has thoroughly soaked into the wood.

Depluming Scabies

Fowls and pigeons are sometimes infected by an itch mite (*Cnemidocoptes gallinae*) which lives at the base of the feathers, causing an intense itching and producing a disease known as mange or depluming scabies. The irritation caused by the mites leads the fowls to pull out their feathers, and they often acquire the habit of feather pulling, attacking the plumage of other birds as well. If the stumps of the feathers are examined soon after the breaking of the quill, they will be found surrounded by scales and crusts, and the adjoining feathers when pulled out will be found similarly affected. In this way the condition can easily be distinguished from molting or the vice of feather pulling, which fowls sometimes acquire without apparent cause. The mites causing the disease are introduced into the poultry yard by affected fowls and spread rapidly from fowl to fowl, finally infesting nearly all in the flock. The disease usually begins in the spring, is most active in warm weather, and largely disappears in winter.

Treatment.—Complete control may be effected by dipping the entire flock in a tub of water containing 2 ounces of flowers of sulfur and one-half ounce of laundry soap to each gallon of water. If the fowls are also infested with lice, the two pests may be eliminated with a single treatment by dipping in this mixture, to which has been added three-fourths of an ounce of commercial sodium fluoride. As the depluming mite is well protected by the skin scales, it is necessary to soak the fowls thoroughly to destroy all the mites. As a soapy mixture of this kind completely wets the plumage, special care must be taken to do the dipping on a warm day when there is little wind. When the infestation is limited to a few birds, or when for other reasons it is not desired to treat the whole flock, the trouble may be held in check by applying to the affected parts an ointment made by thoroughly mixing one part of flowers of sulfur with four parts of vaseline or lard.

The Feather Mite

Infestations with the feather mite (*Liponyssus sylviarum*) have occurred in many flocks during the last few years; it is very injurious in the northern part of the United States. This mite closely resembles the common chicken mite, but has very different habits in that it breeds among the feathers. The eggs are deposited and hatch among the feathers where the young mites may complete their entire development without leaving the fowl. These mites are to be found in greatest numbers below the vent, about the tail, and sometimes on the

neck. The feathers often have a dirty appearance from the presence of the mites, and the skin may be irritated and scabby from the bloodsucking habits of the parasites. The feather mite may first be detected on the hens' eggs, their presence can then be definitely determined by finding groups of mites, their eggs, and excrement among the tail feathers of the chickens. These mites have been found in the nests of English sparrows near infested chicken houses.

Treatment.—Feather mites may be destroyed by dipping affected fowls in a tub containing a mixture of water, 1 gallon; flowers of sulfur, 2 ounces; and soap, 1 ounce.

The feathers should be thoroughly wet to the skin. The head should be submerged for an instant. During the dipping process the mixture should be stirred so as to keep the sulfur in suspension. Dipping should be done only on warm, sunny days, or in a heated building. If treatment is found to be necessary during the winter or early spring months, thorough dusting of the fowls with flowers of sulfur should take the place of dipping.

The nesting material should be removed and burned, and nest boxes, roosts, walls, and floor should be sprayed or painted with anthracene oil as recommended for use against the common chicken mite.

A simpler method than the one just mentioned, reported as satisfactory in some cases but not so successful in others, consists in painting the perches with a 40-percent nicotine sulfate solution shortly before the fowls go to roost, and dusting the nest with sulfur. Nests of English sparrows in the immediate vicinity of the poultry house should be destroyed.

Scaly Leg (Mange of the Leg)

Another species of itch mite (*Cnemidocoptes mutans*) attacking chickens, turkeys, pheasants, and cage birds is the cause of a condition known as scaly leg. While this mite is usually confined to the legs, it may occasionally attack the comb and wattles. The disease occurs in most cases as a result of association with infested birds. It spreads slowly, and many individuals escape it entirely, although constantly exposed to it (fig. 36).

Symptoms.—The disease is easily recognized by the enlargement of the feet and legs and by their rough appearance. The parasite begins its attack in the clefts between the toes and gradually spreads forward and upward until the whole of the foot and the shank become affected. The two legs are usually attacked about the same time and to the same degree. At first there is only a slight roughening of the surface, but the continued irritation by the mites causes a spongy or powdery formation beneath the scales, which raises them more and more until they are nearly perpendicular to the surface and are easily detached. In the most severe cases the joints become inflamed, the birds are lame and scarcely able to walk, a joint or an entire toe may be lost, and the birds lose flesh and die.

Treatment.—The most effective treatment for scaly leg is to dip the feet and shanks of the infested birds in crude petroleum. This can be done most easily by putting the petroleum in a large bucket or tub. In dipping the feet, care should be taken not to get the oil on the upper part of the legs or on the feathers. If a large number of fowls are to be treated, it is best to do the work in the morning. This

gives an opportunity for the oil to dry in and evaporate before the fowls go to roost. Another treatment which has its advocates but is more laborious is to wash the feet and legs with soap and warm water, removing all loose scales. Dry the legs and apply an ointment containing 2 percent of carbolic acid or 15 percent of fine sulfur, or a mixture of Peruvian balsam, 1 ounce, and alcohol, 3 ounces. When crude petroleum is not readily available, kerosene oil may be used as a dip for the feet. With the crude-oil treatment usually one application is sufficient, although in severe cases a second application

30 days later may be desirable. With the other remedies mentioned, a second treatment should be given 3 or 4 days after the first. To prevent the spread of the scaly-leg mites from fowl to fowl it is advisable to apply anthracene oil or crude petroleum to the roosts.



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FIGURE 36.—Bird affected with scaly leg.

Other Mites

Several other species of mites infest poultry. One species bores into the skin and is found in cysts lying on the under surface of the skin next to the muscles. This form is not known to do any serious injury. Still another species occurs in the air passages, liver, and lungs of chickens. Unless present in sufficient numbers to interfere with breathing, it is not a serious pest. Still other mites live among the

feathers of the birds, sometimes causing an unsightly appearance of the feathers but apparently causing little injury to the bird themselves.

CHIGGERS OR HARVEST MITES

Chiggers, harvest mites, or "red bugs," *Eutrombidium alfredduges*, which so frequently annoy campers by the intense itching they produce, may also attack fowls. Young chickens and turkeys having a free range, especially if it includes low-lying lands, are the most likely to suffer from these parasites. The mites attach to the skin, causing an intense itching, and abscesses may be found where clusters of mites are feeding. These abscesses are sometimes a third of an inch in diameter, surrounded by an area of inflammation. The birds become droopy, refuse to eat, and may die from hunger and exhaustion.

Treatment.—If an abscess has not yet formed, the inflamed area may be treated with sulfur ointment, Peruvian balsam, or a mixture of one part of kerosene with three parts of lard. If suppuration has occurred the scab should be removed and the area washed with 4-percent carbolic acid solution. Frequent light dusting with flowers of sulfur will keep the chickens from becoming infested. In the Southern and Central States, where harvest mites are most numerous, it is often necessary to keep young chickens off the range in summer.

In these sections it is a good plan to hatch the chickens early in spring, so that when the warm weather comes, in which the mites are most abundant, the birds will be old enough to resist their attacks.

TICKS ¹²

In some parts of the South, poultry are commonly infested with a species of tick known as the chicken tick or blue bug (*Argas persicus*). This parasite when full-grown may be from one-fifth to nearly one-half inch long and is a powerful blood sucker. In its adult stage of development it has feeding habits similar to the much smaller red mite, in that it feeds only at night and spends the days hiding in cracks in the roosts or walls. Pigeons are occasionally attacked by a similar tick, and both species have been known to inflict painful bites on persons coming in contact with infested birds. These ticks, on account of their relatively large size as compared with mites, can do a great deal of damage in a poultry or pigeon house, and birds attacked by them are likely to succumb from loss of blood or a type of paralysis. Moreover, in the case of the chicken tick, it is known that in some countries this parasite may itself be parasitized by minute organisms (*Spirochaeta gallinae*), which are injected into the blood of the fowl which it attacks, causing a severe and usually fatal fever. In this way the tick acts as a carrier of the disease organism much as the mosquito by its bites carries the organism causing malaria in man.

The first stage of the chicken tick's development is passed on the body, the seed tick leaving the birds when it has become engorged; thereafter the adult attacks chickens only at night, after they have gone to roost.

Treatment.—Chicken ticks are very persistent, and ordinary insecticides have little effect on them. All loose boards and boxes which may provide hiding places for the ticks should be removed and anthracene oil or crude petroleum applied as recommended for the treatment of red mites. After the general spraying, it is usually necessary to apply anthracene oil to the roost, roost supports, and nests several times at intervals of 3 or 4 weeks.

FLEAS ¹³

In the Southern and Southwestern States, poultry are frequently infested by a species of flea known as the sticktight flea (*Echidnophaga gallinacea*) so-called from its habit of remaining attached to one place. This form (fig. 3) also attacks dogs, cats, and some wild birds and animals. On poultry, the fleas are usually found in clusters on the comb, wattles, and around the eye; on dogs they are found on the ears. Young fowls when heavily infested often die quickly. Older birds, while more resistant, have been known to succumb to heavy infestations and even mild infestations reduce egg laying and retard growth.

Treatment.—As a preliminary step in the treatment of fleas, all dogs and cats should be kept away from the chickens and should never

¹² For additional details see Farmers' Bulletin 1070, The Fowl Tick and How Premises May Be Freed From It.

¹³ For additional details in regard to chicken fleas, see Leaflet 152, How to Control Fleas.

be allowed to lie on the ground in the chicken yards. As rats frequently harbor large numbers of these fleas and may therefore keep up the infestation, they should be destroyed by trapping, not only on account of the fleas they may carry but because they are themselves a serious pests to poultry. Sticktight fleas breed in the dust on the floors of hen houses and on the soil under houses and outbuildings. Hence, especial attention must be given to the treatment of the breeding places as well as to the infested fowls. The combs and wattles of the birds may be anointed with carbonated petroleum or sulfur ointment. Great care should be taken, however, not to get any of the ointment in the birds' eyes, as it may produce blindness.

Effective control of the sticktight flea can be accomplished by the use of either DDT or benzene hexachloride (BHC) powder. Both of these insecticides can be obtained in the 50-percent wettable, water-dispersible form. The only equipment necessary is a 10-gallon container of water, to which has been added the powder and in which the birds can be submerged. Best results are achieved by complete immersion rather than by merely dipping the head and neck. DDT can be used as a 0.5-percent suspension, which is made by adding approximately 13 ounces of a 50-percent wettable powder to 10 gallons of water. BHC can be used as a 0.25-percent suspension, which is made by adding approximately 6.5 ounces of a 50-percent wettable powder to 10 gallons of water. After the chickens

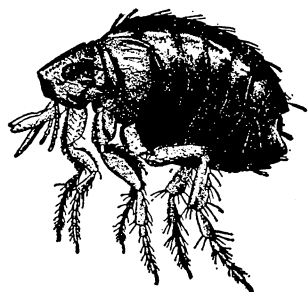


FIGURE 37.—The sticktight flea, adult, female. Much enlarged.

have been dipped, the floors, walls, and nests should be thoroughly sprayed with a larger quantity of the same preparation.

The roosting and nesting quarters, and yards of poultry houses, should be thoroughly cleaned and, along with the floor, sprayed with creosote oil of DDT. Creosote oil is relatively cheap, is usually available, and is remarkably effective against fleas. One-half gallon is sufficient to cover 1,000 square feet of floor space. More is required for dirt floors where considerable dust or litter is present. In most cases, one light spraying will clean up an infestation. DDT may be applied as a 5-percent solution in kerosene or fuel oil, as a 5-percent emulsion in water, or as a 2.5-percent suspension in water. A wettable powder containing 50-percent DDT is available commercially for preparing suspensions by mixing with water. If this is done and fowls are excluded from underneath buildings, or such places are sprayed with creosote oil every 2 or 3 weeks or with DDT every 2 or 3 months, treatment of the fowls is usually not necessary.

THE BEDBUG AND CLOSELY RELATED BUGS ¹⁴

The common bedbug (*Cimex lectularius*) and one of its close relatives, the Mexican chicken bug (*Haematosiphon inodora*) as well as

¹⁴ For additional details in regard to the bedbug and its control, see Leaflet 146, Bedbugs.

the European pigeon bug (*C. columbarius*) and the swallow bug (*Oeciacus vicarius*) may attack domestic birds and may become serious pests. The bugs live in the nests or about roosting places, hiding in the cracks during the day and coming out at night to suck the blood of the fowls. They especially annoy setting hens, sometimes causing them to desert their nests. Since bedbugs may gain entrance to houses and cause much annoyance to human beings, their control is doubly important.

Treatment.—The complete eradication of bedbugs from poultry houses has been achieved with a single application of wettable 50-percent DDT in water. DDT is apparently so destructive to bedbugs that as little as 4 pounds of the wettable 50-percent powder per 100 gallons of water, applied by means of suitable high-pressure spray equipment, is fully capable of eradicating heavy infestations. Enough of the DDT-in-water mixture should be used to saturate thoroughly the poultry house, inside and out. It is always advisable to remove the birds from the building, and to remove and burn all litter, before spraying. A good barrel pump, may be used if a power-driven sprayer is not available.

The Mexican chicken bug responds to treatment with DDT as effectively as the bedbug. However, for a more lasting protection of birds and poultry houses against the Mexican chicken bug, it is advisable to use BHC. Four pounds of wettable 50-percent BHC per 100 gallons of water should be used. The birds should be removed from the building, all litter removed and burned and the spray applied very liberally to walls, floors, ceiling, nesting boxes, and perches. The dirt floors of chicken runs should also be sprayed.

BEETLE AND FLY LARVAE

There are several different kinds of beetle larvae which may occasionally attack domestic birds. Young pigeons especially suffer from such attacks. The larder beetle (*Dermestes lardarius*) and also the meal worm (*Tenebrio molitor*) have been known to kill squabs by eating away the skin at the vent and neck, thus producing serious sores; and larvae of one of the sexton or burying beetles (*Nicrophorus* sp.) may also attack these young birds. The adult of the meal worm, on the other hand, may greatly annoy setting hens, attacking their feet. In addition the screwworm (*Cochliomyia americana*) and larvae of the blowflies (*Lucilia* spp. and *Cochliomyia macellaria*) may be found on domestic birds, the eggs having been deposited by the fly in sores or in the natural openings of the bird's body.

THE PIGEON FLY

In recent years the pigeon fly (*Pseudolynchia maura*) has become a serious menace in many parts of the United States, especially in the Southern States. The flies annoy the pigeons and, when numerous their bites cause considerable loss of blood; in addition, they transmit the organisms which cause pigeon malaria. See page 65 for details in this connection and for control measures.

CAUTION

All disinfectants, whether used in dusts or solutions, are more or less poisonous and irritating to the eyes, skin, and respiratory passages. Persons applying these chemicals should be careful to avoid breathing or ingesting them. Eyes, nose, and mouth should be protected, particularly from the dusts. Goggles, gloves, and in some cases respirators should be worn.

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